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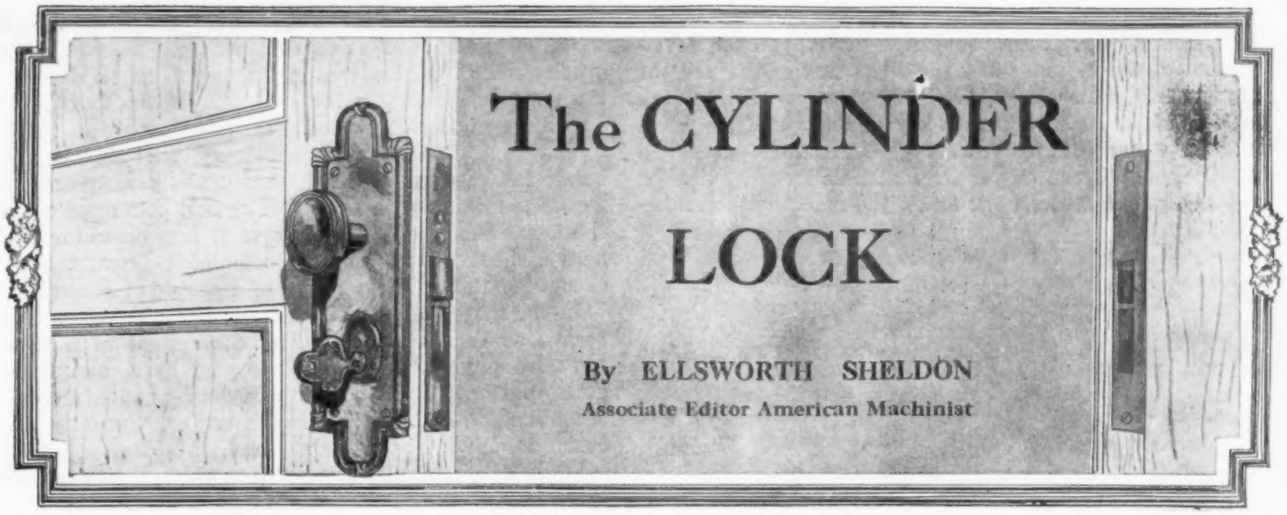


The CYLINDER LOCK

By ELLSWORTH SHELDON
Associate Editor American Machinist

I. General Construction

A manufactured object, familiar to the sight of men all over the world and yet which by its very ubiquity coupled with its unobstrusiveness practically escapes observation, is the cylinder or pin tumbler lock that secures not only the outer and inner doors of our houses, clubs and public buildings, but also protects against molestation the private papers in our desks, our securities in safe-deposit vaults, and even our automobiles when standing at the curb. The attention of the casual observer being called to the slightly projecting circular boss with its peculiar-shaped slot, set in doorplate, desk shield, or automobile lock, will say at once "Yale lock," but the chances are about 10 to 1 that he is wrong. A dozen manufacturers produce such locks, each under his own trade name, though all involve the principle of the pin tumbler, first applied to a modern lock by Linus Yale, Jr., in 1868, and borrowed by him from the clumsy device of some mechanic of the time of the Rameses in the year several thousand and something, B. C.

WHILE the principle on which it is based must in all probability be credited to the early Egyptians, it is to the ingenuity of the mechanics of America who, taking the idea embodied in the clumsy wooden contrivance of the ancients, have through long stages of painstaking experiment developed it into a marvelously perfect piece of mechanism, that we are indebted for the present-day cylinder lock.

So far as we know, Linus Yale, Jr., was the first to give consideration to the Egyptian device, with its series of wooden pins to be systematically arranged by means of a properly notched stick before the bolt could be withdrawn, as the basic principle upon which to construct a practical lock. In a book (History of the Trade-Mark "Yale") published in 1914 by the Yale & Towne Manufacturing Co., is this brief history:

> Linus Yale, Jr., born in Salisbury, N. Y., in 1821, began his career as an artist, but soon gave rein to his inherited aptitude for mechanics by following in his father's footsteps as a designer and maker of locks. His first essays were in his father's factory, the Yale lock shop, in Newport, N. Y., but about 1855 he moved to Philadelphia, where he started in business for himself.

Neither Mr. Yale nor his father had up to this time given any thought or study to the pin-tumbler principle of lock construction, but rather had they devoted their attention to the making of bank locks, in which field both father and son later achieved enviable reputations. The history above quoted goes on to relate how the younger Yale in about the year 1861 removed to Shelburne Falls, Mass., where he continued to make bank locks, and where he conceived the idea of making a self-contained lock that would be entirely independent of any form of key or bit which had hitherto been a necessary part of the lock, and the existence of which rendered the contents of the vault which it protected no safer against theft than was the key itself. The result of his labors in this direction was the dial, or combination lock that, until the introduction some years later of chronometer-operated devices, was the synonym of security and which is still in almost universal use on smaller vaults and safes.

During this period the idea of the pin-tumbler lock was germinating in the mind of the master lockmaker, and in 1868 the form of the lock that had since become indissolubly connected in the public mind with the name of Yale was placed on the market.

The inventor, as is not infrequently the case, did not live to witness the success or reap the benefits of his invention, his death occurring in December, 1868, short-

ly after the founding of the Yale & Towne Co., which had been organized to manufacture his invention and place it on the market.

In the years that followed, the minds of many inventive geniuses have been brought to bear upon the development of the cylinder lock until the lock of the present day in its many varieties, the product of a dozen makers, with its numberless key changes and its pyramidal system of master-keying, bears little except a family resemblance to the original Yale lock.

For obvious reasons the locks, the machines for making them and the methods of production herein described are not those of any one maker, but rather has the writer striven to make the descriptive matter fit a principle which would be a composite of all material available for this purpose.

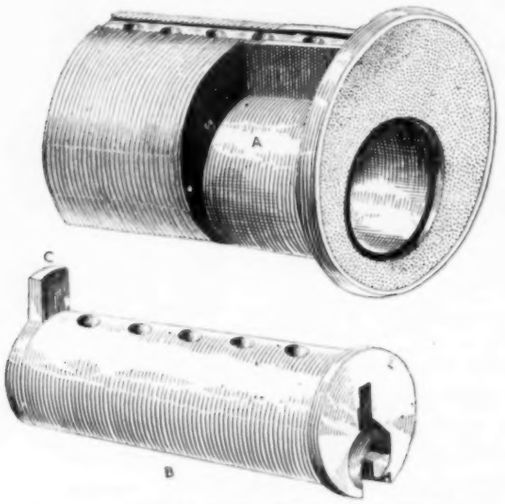


FIG. 1. CYLINDER, PLUG, AND DOG

The central feature of this class of lock is of course the cylinder; the latch or bolt operated by it being a detail dependent upon extraneous circumstances imposed by the nature of the building or structure the lock is to guard.

Fig. 1 shows a perspective drawing of the cylinder, plug, and operating cam used in one of the many forms of cylinder locks. The cylinder itself, marked *A* in the drawing, is usually (not always) a casting of brass or bronze poured in sand molds. Experiments have been made with metallic molds, into which the molten metal is run under pressure as in the modern die-casting machine, but the writer does not know that this method is successfully used at present. The cylinders are cast with a projection upon the large end by which they are held in the chucks of special multiple-spindle automatic machines for performing such operations as drilling the hole for the plug, threading the outside to screw into the lock case, facing the end, etc., as well as other operations of drilling, tapping, milling, or counterboring, that may be peculiar to special forms of cylinders.

The parts are practically completed in one series of operations in these machines, which are not unlike certain kinds of so-called automatic screw machines that are now on the market. There remains but to face off and bevel the front, slot for the seat of the locating screw which determines the position the cylinder will eventually occupy in the lock case, and to drill for the pin, or tumbler holes.

The plug *B* is produced on regular automatic screw machines from rolled or drawn rods of brass or bronze, and like the cylinder, comes finished from the machines except for those operations having to do directly with the individuality of the lock, viz.: the drilling for the tumbler holes and slotting for the key. This latter operation will later be treated in detail, as it is one of the most important in the evolution of the lock and is, I think, unique as a manufacturing proposition.

The cam *C*, is a very necessary part of the lock, being the medium through which the pressure of the key is transmitted to the latch or bolt contained within the lock case. In its usual form it is a punching from heavy sheet brass, coming completed from the dies except for the countersinking of a couple of screw holes.

In the more complicated locks the cam assumes many forms, as for instance in Fig. 4 where it is a square rod of wrought iron held to the plug by a collar, while at *B* in Fig. 2 it is built up of four or five pieces to accommodate it to special circumstances. Its duty, however, is always the same and, besides being the medium of communication between the cylinder and lock case, it serves to hold the plug in the cylinder.

It will be noted that the plug *B*, Fig. 1, has a head at its outer end which fits a counterbored recess in the cylinder, and when the cam is attached by means of screws and dowels to the opposite end of the plug, the latter is held closely against end movement but is free to turn within the cylinder unless prevented from doing so by the tumblers.

While most of the lock cylinders on the market are cast, lockmakers are ever seeking new methods by which their product may be made better, more adaptable, or cheaper. Two, if not all of these desiderata are compassed in the construction shown assembled at *B*, Fig. 2. This cylinder is built up of several parts. The shell *A*, Fig. 3, is drawn from heavy sheet brass. As it comes from the drawing die, it has the two locating grooves, previously mentioned as having to be milled in the cast cylinder, already formed. There remains but to cut the threads on the outside of the shell and to pierce the holes for the cam and the adjusting screw *b*, Fig. 2.

The central part *B*, Fig. 3, is of brass made by the extrusion process in which metal heated to plasticity is forced through dies which determine its shape. This part comes from the extruding dies in practically the

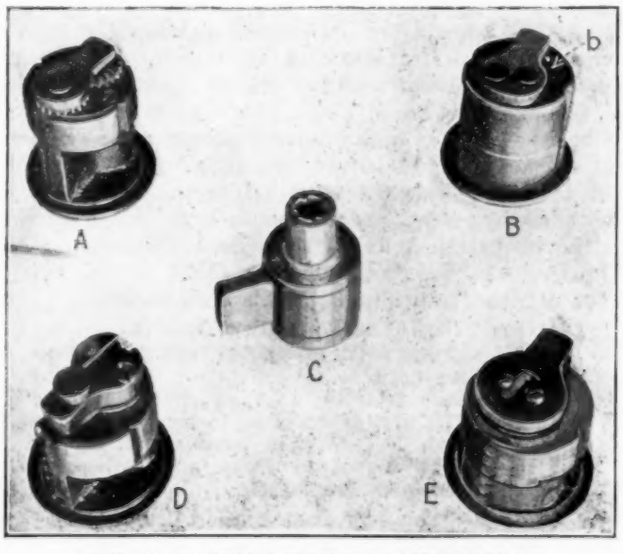


FIG. 2. VARIOUS KINDS OF CYLINDERS

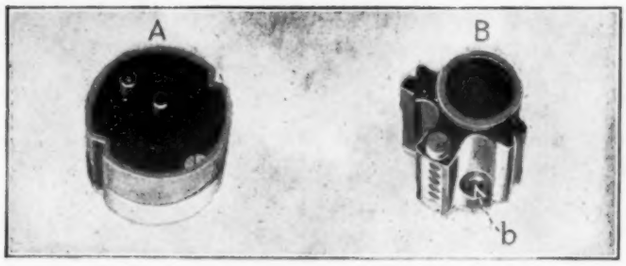


FIG. 3. BUILT-UP EXTENSIBLE CYLINDER

shape shown in the cut except for the necessary drilled holes. The hole for the plug is then drilled, reamed and counterbored, and there are several light milling operations which are barely discernable in the picture. A dovetailed slot is cut along the top to take the cover of the tumbler cells, unncessary stock is cut away at the point *b* where there is a tapped hole for an adjustment screw, and one end is milled to leave three small projections to which is attached the head of the cylinder. It is of course impossible to produce extruded metal with a shoulder and for this reason the head is made separate in the form of a disk pierced with three irregular-shaped holes fitting over the projections above mentioned, which are then riveted over. A thinner piece of brass is spun over the disk making a neatly finished head that is to all appearances integral with the central section. The drilling of the tumbler cells constitutes, of course, a separate operation. The size and shape of the extruded section as well as the inside diameter and shape of the drawn shell are held to very close limits so that the parts go together a tight sliding fit.

How the Cam Is Made

The cam for this cylinder is built up of several pieces. There is a shouldered sleeve fitting the hole in the end of the shell. This sleeve is passed through the hole in the shell and a washer is riveted to it on the inside in such a manner that though the sleeve may rotate, it cannot come out. To this sleeve on the outer end is fastened the cam.

The rivets which hold all these parts together are two long shouldered studs which may be plainly seen in Fig. 3, extending nearly to the open end of the shell. Two corresponding holes are drilled in the plug into which these studs fit, so that when the central section, with the plug in place, is pushed into the shell, the studs are "telescoped" into the plug and establish rotative connection between the plug and the cam whatever position the center may occupy with reference to the length of the shell. The adjusting screw *b*, Fig. 2, holds the two main parts together and provides means of adjusting their combined length to suit the thickness of the door upon which they are installed. As the cam is not available with this construction as a thrust collar to prevent end movement of the plug, it is necessary to provide against such movement by fastening directly to the inner end of the plug a separate piece which has no other function.

Adjustability

Until the introduction of this method of construction, it has been necessary to make the cylinders in various lengths to accommodate doors of different thickness, but with the new type the length may be changed to suit the thickness of any door within its range.

C, Fig. 2, is a cylinder containing two plugs or turning parts, one within the other, and there are three and four sections to the tumblers instead of two and three, as will later be explained in dealing with the master-keying system. Both the plug and the intermediate part are made from wrought bronze, while the outer shell is cast. This is the cylinder used in what is known as the "Unit" lock in which the cylinder is contained within the door knob.

This form of lock is shown in Fig. 4. It possesses some advantages over other forms in the matter of installation but the principle of the lock mechanism is the same as in the others. *D* and *E*, Fig. 2, are cast cylinders each with special forms of cam, the departure in this respect being a part of the master and emergency keying systems, which will be described in a later article.

The pin holes in the cylinder are drilled upon a special machine in which the work is located by a hardened-steel plug, and the drill is guided by a bushing. Only one hole is drilled at a time, the device for holding the cylinder being so constructed as to move the work along the required distance upon completion of each hole, and after all holes have been drilled, to eject the work from the machine. One operator attends six of these machines, which are practically automatic in their operation.

Accuracy Required

In all operations upon the cylinders and plugs it is necessary to maintain accuracy within close limits, there being but 0.002 in. allowed in any part which affects the tumbler holes. It is probably for this reason that one hole only is drilled at a time as mentioned above instead of drilling the necessary five or six at once as could easily be done.

The type of drilling machine and holding fixtures varies with different makers. Some drill the cylinders from the top, while others contend that the liability to inaccuracy is greater when drilled in this way because of the tendency of the drills to run while passing through the material, thus affecting the alignment at the vital point—the break line—which is the point of junction between the plug and the cylinder. For this reason some makers drill the cylinders from the bottom, in which position the drill can be guided by a hole in the steel plug directly to the break line, and if the drill later drifts slightly out of alignment, no serious trouble results.

In either case these pin-holes usually extend clear

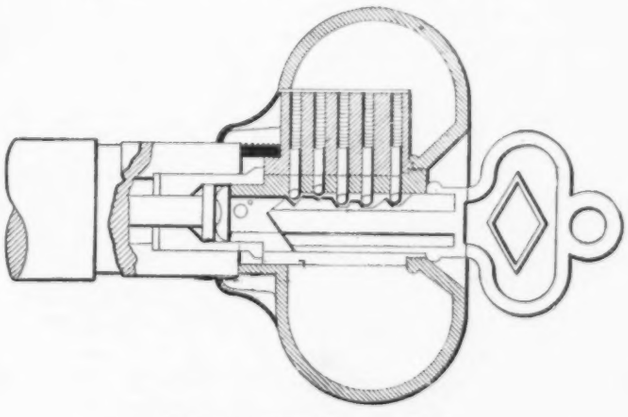


FIG. 4. THE "UNIT" LOCK

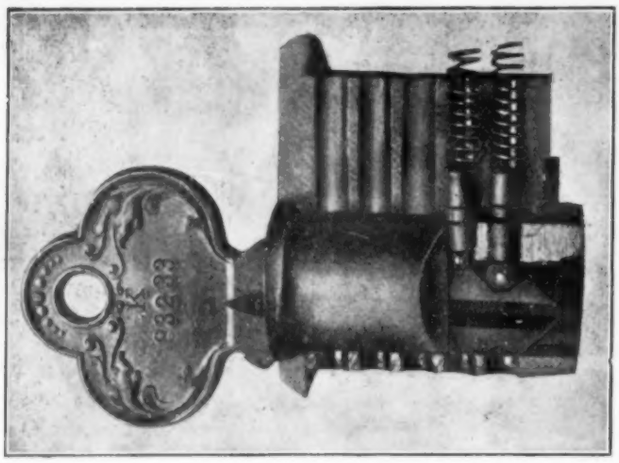


FIG. 5. THE CYLINDER AND PLUG CUT AWAY TO SHOW MECHANISM

through the cylinder, and an operation of hand-reaming follows the drilling.

Filling Up the Holes

The row of holes along the bottom of the cylinder below the plug hole must be filled up because, if they were allowed to remain, they would not only form pockets to collect dust, which is the greatest enemy of the cylinder lock, but the tumblers contained within the plug would fall into them by gravity if the plug were turned half-way over, and thus lock it in a position from which it could not be released without destroying the lock or mutiliating the door.

An ingenious machine has been devised for filling up these holes, in which the cylinder is placed in a fixture the upper part of which is a piercing die containing a row of holes of the same size and to the same spacing as the objectionable holes in the cylinder. A strip of soft brass is now passed over the die, the punches pierce holes in the strip and, continuing their movement, carry the punchings down to the cylinder immediately under the die, setting them firmly in the holes in the cylinder. The latter is supported at the time on a steel arbor fitting the plug hole. As the soft brass punchings stop against the arbor, the pressure of the punches upsets or swages each piece in its respective hole making a tight fit.

The time required for this operation is one stroke of the press, and so neatly is the work done that after the plug hole has been hand-reamed, which is the next operation, it requires a close scrutiny to disclose the fact that these objectionable holes ever existed. A small dovetail slot or groove is profiled along the line of tumbler holes on top of the cylinder on some locks to allow a thin cover to be set in place to act as a retainer for the tumbler-springs. In the final assembling of the lock, this cover is driven lightly into place and it is therefore a small matter for the lockmaker to remove it for the purpose of changing the tumblers if a new "set-up" is desired.

Cross-Section of Cylinder

In Fig. 5 is shown a cylinder, plug and key in which the cylinder has been sawed longitudinally through its center, and the plug has been partly cut away to show the tumbler mechanism. This cylinder belongs to what is known as a "rim latch," meaning a spring lock that is attached to the inside surface of a door instead of being mortised into its edge. The cam in this instance is a disk having a square hole in the center and is attached to the plug by two machine screws. It is not shown in the picture. The square hole receives an iron rod or spindle of the same section which is attached to the dog that bears upon the operating levers within the lock case.

One material difference between the "rim" and "mortise" locks is that in the latter, the cylinder screws into the lock case and its cam bears directly upon the lock levers, while in the former the lock and its cylinder are separated by the thickness of the door, and the connection must be made between the cam and levers by some form of spindle or shaft.

Number of Tumbler Pins

In the lock shown in Fig. 5, there are five tumblers which is the usual number for the majority of locks even though they are constructed to be operated by two or more master keys. On the more complicated master-key locks, however, especially in those designed to be opened by an emergency key, six tumblers are used.

There are also cylinder locks made which are much shorter than the standard. Their principal use is upon desks, the switches and levers of automobiles, etc., where thickness of material is not sufficient to accommodate a standard lock.

These locks generally have but three tumblers and the key is therefore shorter than the regular form. These locks can be so set up however that they may be passed by a regular key if desired.

Drilling the Plug

The holes in the plug are drilled in a manner similar to those in the cylinder. They extend to the center of the plug before the key-slot is made and as the width of the slot is less than the diameter of the hole, the depth of these holes establishes the limit to which the tumblers may fall when no key is in the lock.

"Ball Bearing" Locks

The lock shown in Fig. 5 is called by its makers "ball bearing" because of the hardened-steel balls upon which the tumblers rest. The balls are not an essential feature of the pin-tumbler lock, however, but serve to make the entrance and withdrawal of the key easier by reason of the fact that to lift the tumblers, the upper irregular-shaped edge of the key, which the makers call the bitting, presents at each step what is in effect a wedge of 45 deg. angle, and at least one-half the pressure exerted against the tumblers by this wedge is in a direction parallel to the length of the key.

This has a tendency to throw the tumblers against the side of their respective cells and cause them to bind, while there is a little tendency to bind on the part of the ball, and the latter will of course lift the tumbler directly upward without side thrust.

The second section of this article will outline some of the changes in construction that have been devised in order to enable the lockmaker to keep a lap or two ahead of the deft-fingered gentleman who devotes that portion of his life not spent in jail to a study of the intricacies of such locks and other mechanical contrivances as are likely to be located between him and ready collateral.

Extracts From Chordal's Letters

In this letter Chordal tells us about the ingenious way in which a farmer made a wooden screw and nut for a cider press he was building. From this he passes to a description of a gold watch screw weighing only twelve thousandths of a grain and then back to how a blacksmith repaired the worn-out screw and nut for his vise. The evolution of the screw from a comparatively crude article to one of great refinement has taken place in Chordal's time and we strongly suspect that he knows more about the screws referred to in this article and their makers than he has told.

Mr. Editor:

* * * I once saw a farmer who, by the way, was a pretty good mechanic, making a wooden screw for a cider press. The screw was about 12 in. in diameter and about two threads per foot pitch.

Fig. 1 will fairly illustrate the press, and the size of the parts may be gathered from the size of the hammer which I have shown on one of the uprights.

This chap took an oak log and sawed the ends off squarely and then struck circles on the ends, circles of about 12 in. He used a piece of weatherboarding for a straight-edge and with a broadaxe he hewed this log to the circles and produced a pretty fair sort of a cylinder. He finished it up with a draw-knife and then was ready to produce his thread. He made long strips of newspaper the width of his thread, and these strips he cut with a jack-knife, using his straight-edge. The newspaper he used formed comparatively short pieces which were spliced together by pasting. He used two of these long strips which he wound around his log, fastening the ends, not with thumbtacks, which he had probably never heard of, but with tenpenny nails. He wound two strips side by side and then removed one of the strips. He then marked his thread with a pencil at the edges of the paper strip and removed the strip.

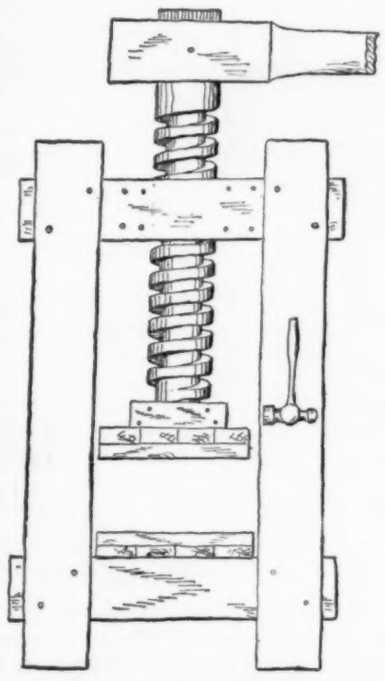


FIG. 1. A CIDER PRESS

* * * He cut out a piece of shingle representing the width and depth of his thread and he then proceeded with saw and chisel to cut out the thread, working to the pencil marks and using his shingle templet, and finishing up the sides and bottom of the thread by hand chiseling. I watched him while doing this work and I take off my hat to him as a workman. He was always sharpening his chisel and he made a good job of the screw.

* * * When it came to the nut I wondered how he was going at it. The nut was made in two halves, in the faces of which he chiseled the half rounds. He would lay the screw down on one of the halves and mark for the width of the thread and he then used his templet to lay out the thread on the face of the block. He then bent a strip of paper and marked for the threads in the half nut and then proceeded with his mallet and chisel.

* * * When it came to the final fitting there was some nice work, chiseling here and there on the screw and on the nut, but when the thing was done, and I got to see it finished, it was a pretty good sort of a rig. The frame was of timbers hewed out with the broadaxe, and as I look back on that thing, with all admiration for the skill of the man who did the work with few tools, I can see that his press when it was done would not compare with the ordinary cider mill press, either in cost, as measured in labor, or in squeezing power. I now doubt very much if the man who built this press did any figuring whatever except to get things strong enough. I doubt if he ever knew or cared as to what was the pitch of his screw, or what was its power, or how it would compare in power with the screw of an ordinary cider mill press, which screw, by the way is, I believe, generally three threads to the inch.

* * * But I have before me an entirely different kind of a screw, a screw used in the smallest watch made by the Elgin Watch Co. This screw is made of gold and looks like a grain of yellow dust. Fig. 2 is a drawing of this screw 40 times the natural size.

The total length of this screw is twenty-eight thousandths of an inch; the diameter of the head twenty-six thousandths of an inch; the diameter of the threaded part twelve thousandths of an inch; the pitch of the thread is three hundred and sixty per inch. The weight of one screw is twelve thousandths of a grain, making 583,333 screws to one pound, avoirdupois weight.

* * * While these little watch screws are of gold, the material in them cost far less than the wood of which the farmer-carpenter made the wooden screw of the cider press, but when it comes to the labor, the case is far different. These watch screws are made from gold wire in a screw machine by a girl and they drop out finished at the rate of one per minute while the wooden cider-press screw, after the log was rounded up, consumed a month's time in the formation of the thread, though the man did not stick to the job for his ten hours per day.

* * * The gold screw of the watch could not, so far as I know, be produced by hand, without the use of thread-cutting dies, and the wooden screw of the cider press would not lend itself to the system of machine production followed in the watch factory. I

have read, somewhere, of the method of producing, in India, I believe, wrought-iron screws by the hammer and chisel method very much similar to the plan followed by the farmer.

* * * This screw business reminds me that when I was a cub I watched a country blacksmith renew the screw and nut of his Peter Wright vise. The square thread on the screw was about worn out and the thread in the nut had completely stripped. The thread was about four to the inch. If I had been in this blacksmith's place and worked in the machine shop, I would have forged a new nut, or "box" as they call it, and would have drilled it out and cut a thread in it, and would then have made a new screw.

FIG. 2. WATCH SCREW (enlarged 40 times)

* * * But this blacksmith had another way of doing things. He made a coltsfoot chisel and chiseled out all the worn threads from the box, and then chopped and filed off the worn thread of the screw. He then took a nail rod and forged out a long square wire for his thread and, heating this wire, bent it across his screw, using two wires lying side by side. He unscrewed one of the wires, leaving a complete but loose thread on his screw. Next he dosed it with flux and brazing and then brazed the thing in his forge, leaving his screw complete and requiring only a little dressing up with the file. He then dosed his box with flux and brazing and screwed his false wire back on to the screw and poked the whole thing into the box and unscrewed the screw, and brazed the false wire into the box. When he was done the thing acted up all right though I have serious doubts as to the strength of the affair for, judging from the screw part of the job, its brazing was not complete at all points.

Yours very truly,
CHORDAL.

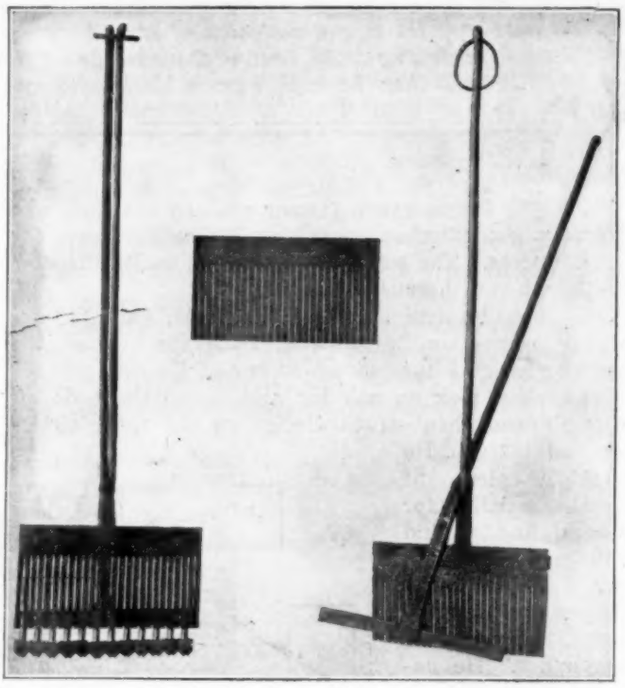
Special Tongs for the Hardening Room

BY PETER F. O'SHEA

The difficulty of handling small articles efficiently while they are being dipped in the hardening room and again in tempering is partly overcome in the Greenfield Tap and Die Corporation by using special tongs, designed by the foreman of one of their hardening rooms. The construction of the tongs is shown in the illustration. It will be noticed that one jaw is made longer than the other. To the short jaw is welded a crosspiece 8 in. long, and to this is riveted a special attachment made of a flat piece of steel cut on a milling machine into a row of spring fingers about 5 in. long, resembling a comb. The other jaw of the tongs has a crosspiece welded to it, which grips against this strip of spring fingers near their end or against whatever work is held between the two jaws.

Small pieces to be hardened or tempered are arranged in a row in a special block or box which has the front side cut away, so that the ends project over the edge of the block. The whole is then gripped in the tongs and the 9, 12 or 16 duplicate pieces are placed in the furnace. When heated sufficiently they are dipped all at once. A ring in the end of one handle of the tongs slipped over the end of the other gives a firm hold on the work so that there is no danger of dropping.

The fingers are made from a piece of excellent quality spring steel. The spaces between the fingers are milled up to within 1½ in. of the other side of the strip. The quality of the steel is such that the fingers last for some years without losing their spring qualities. When they are finally burnt away by repeated heating the rivets fastening the special jaw to the



SPECIAL TONGS FOR DIPPING SMALL ARTICLES

tongs can be knocked out and a new set of fingers put on. In this way one pair of tongs lasts indefinitely.

In the illustration a complete pair of tongs is shown at the left holding work and at the right with jaws open. In the center is an extra jaw or set of spring fingers. It will be noticed that the steel fingers grip closely whatever form of work is in them, each one springing down individually until it brings up against the material.

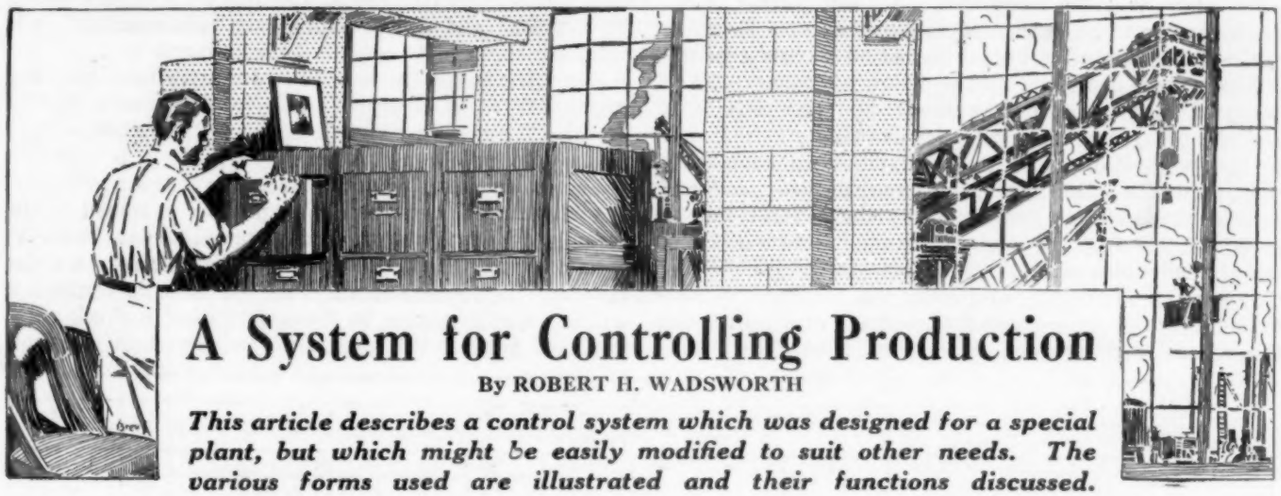
Balancing Crankshafts

With the apparent tendency for higher speed motors for automobile and similar services, the balancing of the crankshaft and similar points becomes increasingly important. It is also more necessary than ever to realize that static or standing balance bears almost no relation to dynamic or running balance. Not only does standing or static balance fail to indicate the dynamic properties of a revolving body, but the amount of static unbalance bears no relation whatever to the dynamic unbalance of the shaft as a whole.

Recent tests by the Carlson-Wenstrom Co., of Philadelphia, indicate this very clearly. Tests on six shafts show the relation between static and dynamic unbalance and show that they bear no direct ratio to each other.

The following table makes this strikingly clear:

Shaft No.	Static Unbalance	Dynamic Unbalance
1	4 ounce inches	160 ounce inches
2	⅜ " "	336 " "
3	¾ " "	168 " "
4	1 " "	288 " "
5	2¾ " "	255 " "
6	1 " "	72 " "



A System for Controlling Production

By ROBERT H. WADSWORTH

This article describes a control system which was designed for a special plant, but which might be easily modified to suit other needs. The various forms used are illustrated and their functions discussed.

THE system herein described was designed for a shop where the quantities of any one single product are not large, and the variety of styles and sizes is considerable. The product of this plant was chiefly centrifugal pumps. While most of the parts of a pump are standard for that size, some of them can be used on another size, and still more of them can be used on other styles of the same size of pump, such as two- and three-stage pumps. Thus some parts may be made in very respectable stock quantities, much larger than the quantity of single-stage pumps of that size that are sold.

The fundamental ideas involved are those of scientific management as advanced by Dr. Frederic W. Taylor and

Finished Stock — Matl. C. I. — Part No. 10100

Name Bracket — Weight each 4.5# — Cost each

Minimum over Requirements 50 — Standard quantity to make. 200

Date 1918	Received Quan'ty	Ord. No.	Issued Quan'ty	Ord. No.	On Hand	Requirements Quan'ty	Ord. No.	Balance over Req.	In Process Quan'ty	Ord. No.
10-1		Bal			100	200 ✓	9237	50		
2			40	9236	60			250		
5			25	9200	35			210		
13	171	123			221			281		
14			50	9237	305					
16						40	9239	161		
19			20	9100	185			141		
21			5	9101	180			136		
23			41	9251	139					
28						30 ✓	9240	110		
30			40	9118	100			70		
11-4						60 ✓	9243	210	200 ✓	125
5			30	9240	70					
7						30	9244	130		
11			30	9243	40					
14	190	135			230			170		
16			30	9241	200 ✓					

FIG. 1. FINISHED STOCK CARD

Raw Stock — Matl. C. I. — Part No. 10100

Name Bracket — Weight each. 5# — Cost each

Minimum over Requirements 200 — Standard quantity to make. 250

Date 1918	Received Quan'ty	Ord. No.	Issues Quan'ty	Ord. No.	On Hand	Requirements Quan'ty	Ord. No.	Bal. Over Req.	In Process Quan'ty	Ord. No.
10-1		Bal			251			250		
2			200	123	50			300 ✓	250 ✓	76
7	50	96			100					
9	50	96			150					
12	50	96			200					
13	55	96			255					
14	55	96			310			310		
16	55	96			365			360	250 ✓	78
11-4			200	125	165					
7	60	78			225			410	250	81
9	60	78			285	300 ✓	127			
11			200	127	85			410		
12	60	78			145					
14	50	78			195					
16	50	78			245 ✓			430 ✓		

FIG. 2. RAW STOCK CARD

Messrs. Emerson, Gant, Going, Babcock and others. In an effort to approximate the results of scientific management without going into such elaborations as have been employed in that name, and recognizing that a process of evolution is more palatable than revolution, certain principles of scientific management have been kept in mind and a system designed about them which if thoughtfully employed cannot fail to bring results.

One thing must be remembered in installing any system; it must have a person in active charge who is capable, interested and responsible for the system and its results. If a system is left to several operators and a chief whose principal interests are elsewhere, it will not long continue to be a system, for certain features will be neglected, and others modified, without due consideration of their effect on the system as a whole. Results will be inferior, condemnation will follow, and the system is gone. This has been the history of so many well-directed attempts that it is considered salutory to introduce these remarks.

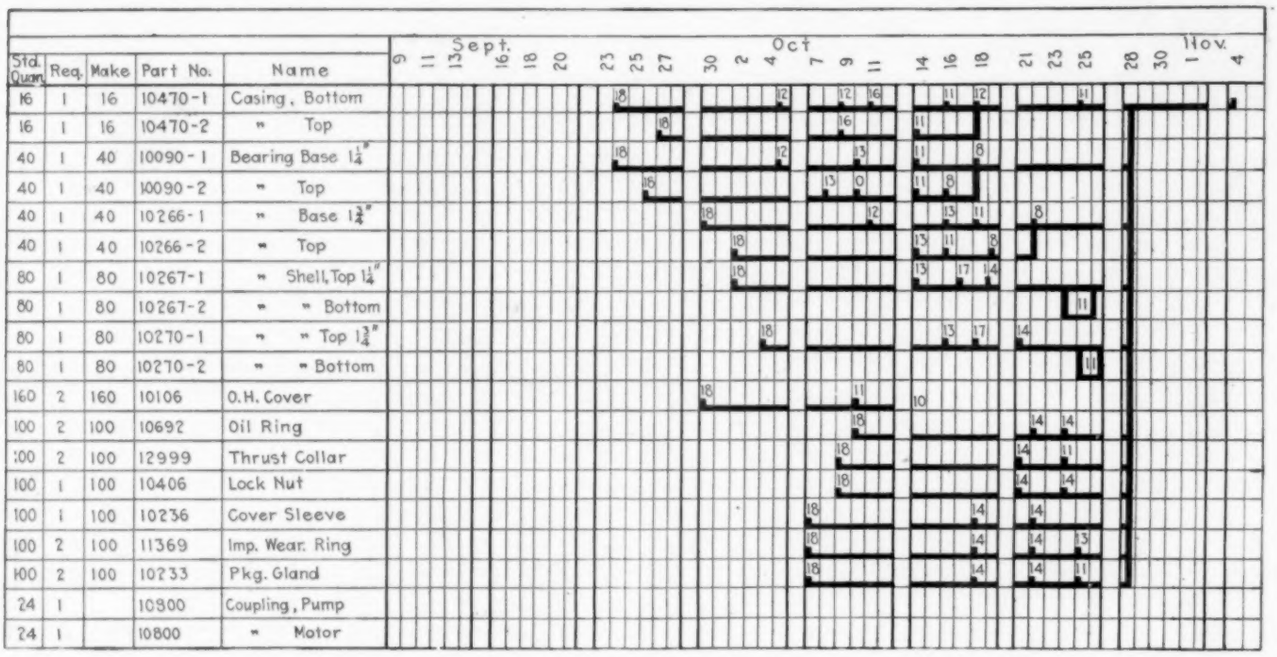
Few of the forms and methods used are distinctly original; one or two have been employed in one concern, a third in another concern and so on. The good points of all such forms and methods have been retained and remodeled to form a part of a definite and complete system and presented here.

Acknowledgment is here made of the helpful contributions received from various concerns, prominent among which are: the Cincinnati Milling Machine Co.; the Lodge & Shipley Machine Tool Co.; the Goulds Manufacturing Co.; the International Machine Tool Co.; the Cincinnati Planer Co.; the H. H. Franklin Manufacturing Co.; the Westinghouse Machine Co.

The practical application of scientific management has system for its vehicle. Such a system is not like Topsy in Uncle Tom's Cabin who "just growed," but is a materialization resulting from an analytical and coördinately constructive study of the conditions pertaining to a certain enterprise. Such a system will facilitate the transfer of necessary information with the greatest dispatch and accuracy, will provide for the prompt accumulation and convenient arrangement of all information originating in the office and the shop, and will avoid all unnecessary effort. An ideal system is one that will record all manufacturing activitv in such a way that any desired information about a product can be ascertained promptly and reliably. It will advise what parts are in stock finished, for what parts material is in stock rough, and the location of all parts in process, their condition of finish and the date

when they will be completed. It will advise when machines are to be assembled and promises of shipping can be made on an intelligent basis and be carried out.

The system described in the following paragraphs is designed to advance orders from the manager's desk and the order department to the drawing room, thence to the production office and the shipping room. In the production office appropriate records are made and suitable instructions are issued to the several departments of the shop for manufacturing. Charts are also maintained which schedule the processing of the product through the various departments, and methods of communicating the progress of the work are maintained and the results are recorded on charts. The charts thus



Std. Quan.	Req.	Make	Part No.	Name
16	1	16	10470-1	Casing, Bottom
16	1	16	10470-2	" Top
40	1	40	10090-1	Bearing Base 1¼"
40	1	40	10090-2	" Top
40	1	40	10266-1	" Base 1¾"
40	1	40	10266-2	" Top
80	1	80	10267-1	" Shell, Top 1¼"
80	1	80	10267-2	" " Bottom
80	1	80	10270-1	" " Top 1¾"
80	1	80	10270-2	" " Bottom
160	2	160	10106	O.H. Cover
100	2	100	10692	Oil Ring
100	2	100	12999	Thrust Collar
100	1	100	10406	Lock Nut
100	1	100	10236	Cover Sleeve
100	2	100	11369	Imp. Wear. Ring
100	2	100	10233	Pkg. Gland
24	1		10800	Coupling, Pump
24	1		10800	" Motor

FIG. 3. CHART OF OPERATIONS

visualize the necessary procedure of the work and its progress whether on time or tardy. A method is maintained of obtaining accurate labor and machine costs, by which the cost department can compute accurate costs per part and for each assembled group. A method is provided whereby the sales department is provided with data upon which reliable promises of delivery can be made on all regular products.

Operation of the System

The finished stock card, Fig. 1, is the first form to be considered in this system. In addition to the usual record of "received," "issued," and "balance on hand," provision is made for "requirements," "balance over requirements," and "orders in process." In order to provide against confusion and errors in maintaining proper records, but one column is provided for each date, and but one movement of stock may be recorded on any one horizontal line. The "on hand" and "balance over requirements" columns are always corrected after any changes in the records.

The detail requirements of every customer's order forwarded to the production office will be recorded on the finished stock card in the column headed "requirements." If the "balance over requirements," corrected after an entry in "requirements," is below the minimum over "requirements" on head of card, an order to make more parts must be entered and will be recorded under "in process" and the "balance over requirements" will again be changed to include this new order.

When the parts on such an order have been received in finished stock, entry is made in the column headed "received" and a check mark is placed against this order in the "in process" column to indicate it is finished. "Balance on hand" and "balance over requirements" are corrected as required. When stock is issued to the assembling department, it is recorded under "issued," and "on hand" is corrected. If the issue is for an order recorded in "requirements," and the issue is equivalent to the quantity named in "requirements," a check mark is placed against this order in "requirements" to show that it has been provided for. There are four simple rules which control and prove all records on this card. These rules should be posted near the cards:

1. "Receipts" don't change "balance over requirements" till order "in process" is closed.
2. "Issues" don't change "balance over requirements" when made for exact amount in "requirements."
3. "Balance on hand" + "in process" — "unfilled requirements" = "balance over requirements."
4. "Amount forward" + "receipts" — "issued" = "balance on hand."

The raw stock card, Fig. 2, is next in sequence. It operates exactly the same as the finished stock card. The "minimum over requirements" has been set to have in raw stock enough pieces to fill one standard manufacturing order.

When an order to make is recorded on a finished stock card, parts from the raw stock are sent to the shop and recorded on the raw stock card as "issued." If the "balance over requirements" is then lower than the "minimum over requirements" on the head of the card, an order for raw stock must be made and is recorded "in process." It will be of interest to follow the figures recorded on these two cards.

When it is advisable to enter an order to machine parts for finished stock as noted on the finished stock

OPERATIONS		Matl.	Part No.		
Name			Dwg. No.		
Dpt.	Operation	Set up	Time	Tools	Mch.

FIG. 4. OPERATIONS CARD

card, order numbers 123 and 125, the chart representing the assembly group in which this part appears is consulted, Fig. 3. All the items entering into this assembly group are investigated as to the amount in the column of "balance over requirements." In the column on the chart headed "make" is recorded the quantity to be made for all items on the chart requiring replenishment. It is always preferred to make the "standard quantity."

In the first column on the chart is recorded the standard quantity, and in the second column the number of pieces in one assembly group. The several narrow columns represent the days of the week, the weeks being

DELIVERY NOTICE

From Dept. _____ To Dept. _____ Order No. _____

Date _____ Part No.

Quant'y	Name	Condition

Sent by	Received by

FIG. 5. DELIVERY CARD

indicated by heavier column lines. To put the chart into operation requires that an order number be assigned and that dates be entered at the head of the chart.

The purpose of the chart is to visualize the time required for the manufacture of the various parts entering into one assembly group, and to trace the operations on the work to see that they are completed according to schedule. The time required for each operation on the standard quantity is determined. To this is added such time as seems advisable, from a few hours to two or three days, to move the work from one operation to the next and to get a machine free so that the work may be started.

A time at which all parts must be finished and in stock waiting for assembly is determined, and is represented on the chart by a heavy vertical line to which other heavy horizontal lines representing the operating

ASSEMBLING ORDER

Date Lot No. Order No.

Date to assemble.

Description.

Mounting

Serial No.	Assm.	Wtd.	Serial No.	Assm.	Wtd.	Serial No.	Assm.	Wtd.

FIG. 6. ASSEMBLING ORDER

times of the various parts connect. **The time allowed for the last operation on each piece is determined first and is set off to the left of the heavy vertical line** accordingly and the department number is written over. The time for the next operation is similarly determined and is charted to the left of the last operation. This process is continued till the first operation has been charted. An additional 10 days is charted to the left of the first operation to provide that the raw material be checked up to see if it is properly available. If

Foundry Order

Issued Wanted Part No.

Quantity Material Dwg. No.

Name Order No.

Good Castings

Date	Quantity	Date	Quantity	Date	Quantity
				Total	

Completed Forem'n.

FIG. 7. FOUNDRY ORDER

it is not properly available, there are 10 days left to get it without missing the schedule.

As each operation is completed in the shop, the production office is advised by a delivery notice, Fig. 5. A clerk records on the charts the progress of the work as

TESTING ORDER

Date Lot No. Order No.

Date to test

Description

Mounting

Serial No.	Tested	Serial No.	Tested	Serial No.	Tested

FIG. 8. TESTING ORDER

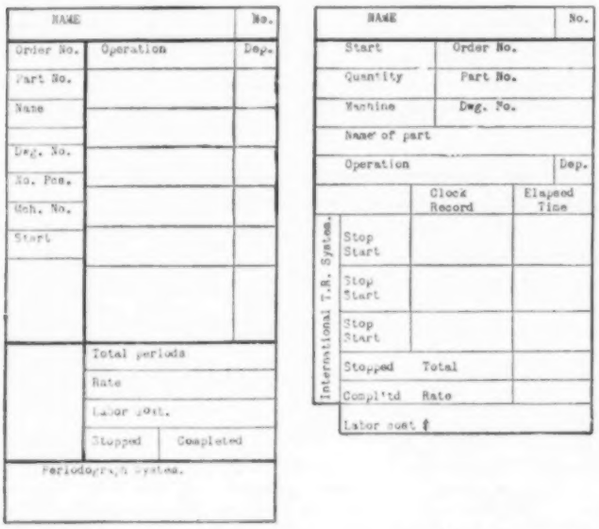
advised by the delivery notices. He also inspects the charts daily to observe if the work is all up to schedule. Any work that is not up to schedule is at once investigated and the necessary steps are at once taken to get it back on schedule. Once a week the chief of the production office goes over the charts to observe if the work charter for completion is on schedule, and following these observations, he makes up a schedule of work for the assembly department for the ensuing weeks. It will be noted that one week is charted after the completion of all parts. This week is allowed to guarantee all parts completed and in stock over and above any delays that might have occurred. The following week assembly is to proceed without interruption or delay.

Sometimes one part must be partly machined and then associated with another before the two may be finished. This is exemplified in the 2nd, 4th and 6th items on the chart. Another arrangement may be charted, so that when one operation requires considerable time, another may be started before the former one is finished. This will reduce the total time required

to advance the product from the raw stock to a finished condition. By the aid of the department numbers given below, a detailed study of the chart may be made.

1. General Office
2. Order Dept.
3. Purchasing Dept.
4. Drafting Room
5. Production Office
6. Shipping and Receiving
7. Testing
8. Erecting
9. Wheel assembly
10. Finished stock
11. Drilling
12. Boring
13. Milling
14. Lathe
15. Screw machines
16. Planing and slab milling
17. Babbit
18. Raw stock
19. Clean castings
20. Foundry
21. Pattern
22. Tools

The standard quantity recorded on the finished stock card and on the chart is determined carefully, and is the quantity which should always be employed in making up new orders. The quantity is determined thus: A certain machine may accommodate a number of parts at one load. The number of parts on the other should be a multiple of that number. If the part in question is one requiring a high percentage of time to set up the machine as compared to the production time for



FIGS. 9 AND 10. PERIODOGRAPH TIME CARD AND CLOCK-RECORD TIME CARD

one piece in that operation, as is the case with a screw machine or an automatic machine, it is advisable to make the standard quantity as large as the conditions of handling, storage and sales will warrant, without interfering with the manufacture of other parts. If not many of these parts are used, it may be advisable to make enough to last a year, as is indicated by sales. This method will divide the non-productive cost among a maximum number of pieces, and the lowest possible non-production cost per piece will then result.

Departmental orders, Fig. 11, are made out from the completed chart, and the routing and schedule is written on as recorded on the chart. One order for each department involved is provided, and also one copy for the production office and one copy for the inspector. The paper on which these orders are written is thin and firm so that several orders may be written at once on a typewriter. A flat-bed typewriter is advantegous for this work. The foreman of a department files these orders in a loose-leaf book, and may make any notes on his order that will be helpful to him. The order tells him when the work is due to him, where it comes from, the condition of finish, the time he should start his work, and the time it should be available for the next operation. When the work has been completed in his department, he notes the delivery on his order and removes the order to another book marked "finished."

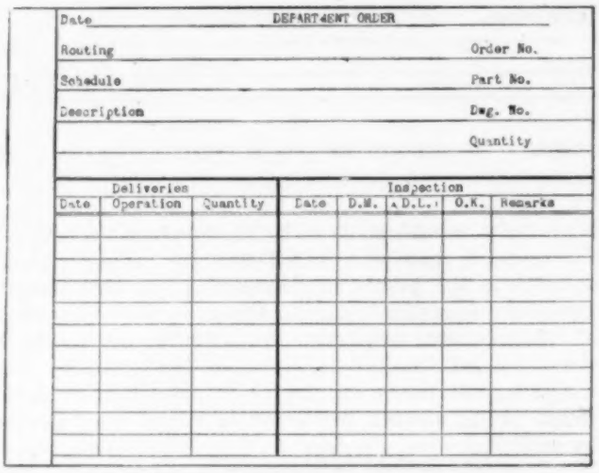


FIG. 11. DEPARTMENT ORDER

On the copy of this order furnished the inspector, he records receipts of stock from each operation under "deliveries," and under "inspection" he will note results of the inspection.

When, according to the routing on the head of the order, the last operation has been inspected, the inspector's copy of the order will be sent to the production office to have recorded the experience on the job, and then it goes to the cost office to form the basis of part costs. It advises how many pieces were started, what was lost at each operation and how many finished.

Assembly and testing orders, Figs. 6 and 8, are similar to departmental orders in that they are written on thin paper for a loose-leaf book. These two orders may be written at once on a typewriter together with a third for reference in the production office.

A delivery notice, Fig. 5, is filled out in duplicate for every movement of stock, both single parts and assemblies. Both copies go with the work to the next department; the original is acknowledged and sent to the production office, and the copy is retained as notice that the stock has arrived.

The 3 x 5-in. operations, Fig. 4, is made out on tracing cloth for each piece. It gives the general instructions for each operation, the time allowed to set up the machine, and the time allowed per piece for premium, piece work or bonus. It advises the number of tool or fixture equipment, and the number of the machine tool on which the operation is to be conducted. A print from this tracing is made every time a print of the drawing of this part number is made for the

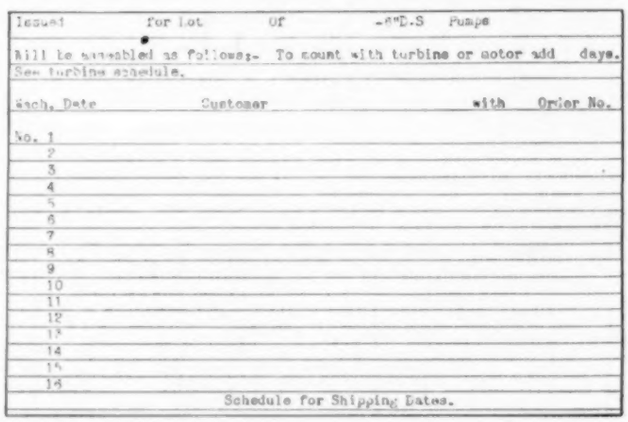


FIG. 12. SCHEDULE FOR SHIPPING DATES

shop, and it is sent with the drawing to the drawing storage in the shop. Here the drawing is mounted on a piece of binders' board and the operation is mounted on the drawing. Thus the operation instructions are always with the shop drawing.

A reliable system for securing time for each operation or job in the shop is desired. One of the several systems employing clocks or other time-recording devices are preferred. Two sample cards are shown, one as employed on the Gisholt Periodograph and the other as employed on the International Time Recorder, Figs. 9 and 10.

These cards are designed to be used as "next job cards" and are made out when an order is furnished the department. The foreman determines what operator will do this work, the time-keeper writes the name of the operator and the number at the head of the card, and places the card in the card rack under the operator's name, and in relation to other cards already placed as may be indicated by schedule dates given under "start."

When the operator is nearly finished with his present task, he notifies the time-keeper who orders the work placed and the tools and drawings secured for this operator for the next job. When the present task is completed the operator advises the time-keeper, his card is punched for "stop" on this job and the next one punched for "start." If the task is completed, a check is placed in that space; if only stopped, a check is placed in that space and the card reserved till the job is finished. When the job is finished, the card is sent to the production office and then forwarded to the cost department, where the cost is tabulated and the time is totaled to check against the daily in and out time. It has been found that with this system it is quite sufficient to check against the in and out clock once a week. This arrangement therefore accomplishes four things with one card:

1. A next job card.
2. A reliable time record of one operation.
3. Information for labor cost per piece.
4. A check against in and out clock and payroll.

The foundry order, Fig. 7, is printed on a 4 x 6-in. card and furnished the foundry for each quantity of a part to be made. The foundry foreman can record his progress on the orders. When the order is completed, he sends the card to the production office with his signature.

The schedule for shipping dates, Fig. 12, is filled out when a chart is made for any lot of machines. It is sent to the sales department as a basis for promising deliveries to the customer. As a machine is sold, the customer's name is inserted opposite the machine number, and an order number is recorded for the assembly and shipment of same.

Methods of Gating Metal Patterns

By Leonard C. Lotz

When the average machinist or toolmaker tackles a metal pattern job he is at loss nine times out of ten to arrange the gating to suit the foundry. If the patterns are to be used in a jobbing foundry, it is best to get the foundryman's idea of the proper size spur, and how many patterns can be placed in the size of flask he has on hand. I shall endeavor in this article to explain various methods of gating patterns that have met with approval.

Fig. 1 shows a row of bushing patterns attached to the gate *A*. If the bushings are to be run in brass the sprue center *B* is placed on the end of the gate as shown, but if the castings are to be of iron it is put in the middle. It is advisable to make this sprue center pear-

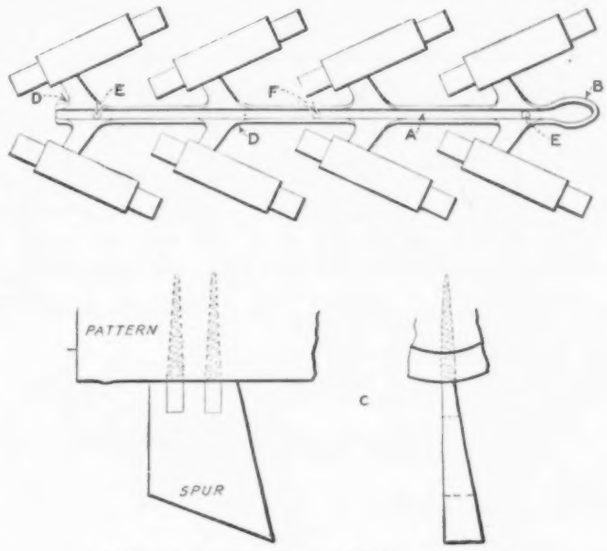


FIG. 1. A SINGLE-GATED PATTERN

shaped to allow a free run of metal to the spurs. The gate and spurs can be made from cast brass, the spurs being tapered to about $\frac{1}{16}$ in. as shown at *C*. These spurs can be fastened to the pattern by brass screws tapped into the pattern, or wood screws if the pattern is of wood. The heads of the screws are cut off and the spur is slotted and soldered to the screws. The sharp corners should be filled in to prevent the metal washing loose sand into the mold. Steady pins *D* of ample length are riveted into the gate. One rap and draw hole *F* is sufficient unless the gate is very large.

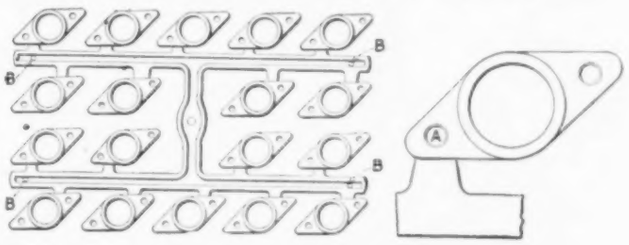


FIG. 2. THE H-FORM OF GATE

Iron patterns should be gated with brass spurs to prevent patterns breaking away from the gate. Good results are not always obtainable from gated white-metal patterns, as they are easily rammed out of shape. The weight of white-metal patterns is also a serious handicap.

Brass-gated patterns are looked upon with favor by the molder, and if cored out to reduce the weight good results can be obtained. Fig. 2 shows a gate of brass patterns. The wood pattern from which the metal patterns were made has the spur attached so that the spur is part of the casting. It is well to have the wood pattern very smooth so as to save filing; also to be sure to have castings made of a brass composition that is not too hard, otherwise the spur will break off after a few molds are made. One must bear in mind not to run the spur into a fine pocket of sand as shown at *A*, as this

would cause the sand to wash into the mold thereby spoiling the castings. A machined surface, or a spot that can be easily ground off, makes a good place to attach the spur. Fig. 2 shows the H-form of gate which allows the molders to get more production than the

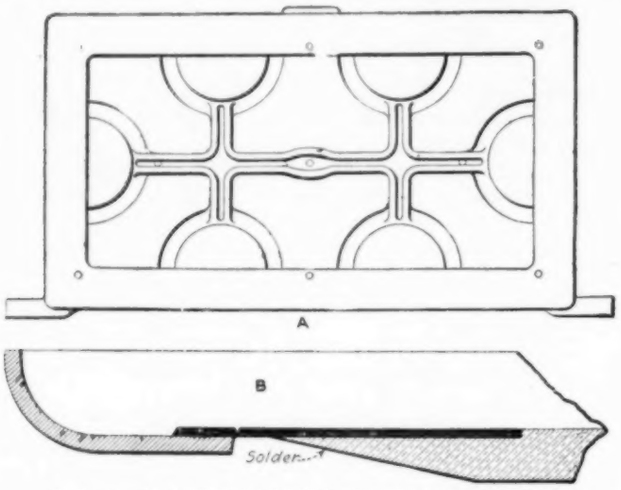


FIG. 3. GATING LARGE PATTERN IN CENTER

straight-run gate. The gate can be cast from a wood pattern and the gland patterns soldered to it. Steady pins are shown at *B*. These should extend not less than 2 in. above the gate.

The method of gating a gas-oven door casting is shown at *A*, Fig. 3. The attention of the reader is called to the fact that the spurs are placed in the opening of the pattern. This allows the metal to reach the mold quickly without becoming chilled. The pattern is usually made of cast iron so as to retain its shape, but the gating or spider is cast in brass to prevent breaking when the pattern is rapped by the molder. In joining the spurs to the main pattern, spurs of brass are used and inserted as at *B*. This makes a strong spur that

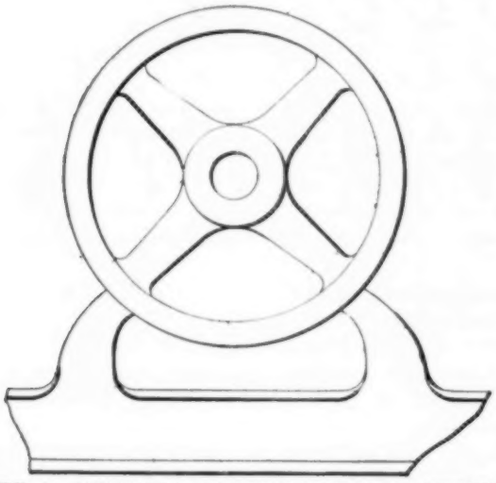


FIG. 4. METHOD OF GATING LARGER PATTERN

will transmit rapping of the gate to the pattern. At the point where the spur joins the pattern a small nick is filed, which allows the gate to be broken off after the casting is poured. Some castings require more than one spur; especially the larger sizes. In Fig. 4 the spurs run into the arms of the handwheel, allowing a free flow of metal throughout the mold, at the same time providing a better fastening to the gate. When a pattern is too large to allow more than one in a mold, the gate is attached as shown in Fig. 5, the rap and draw holes being placed in the centers *A*.

Aluminum patterns produce good results when used where brass or iron would be too heavy. Care should be taken to core out all heavy pads, bosses, or hubs; otherwise those places will shrink and distort the pattern.

Cast-iron coreboxes make the best equipment for most metal patterns, as they retain their shape after

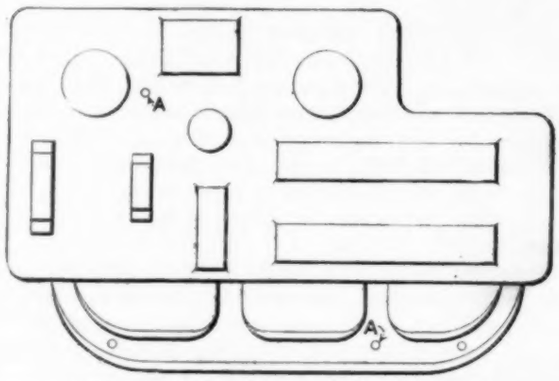


FIG. 5. SIDE-GATING LARGE PATTERN

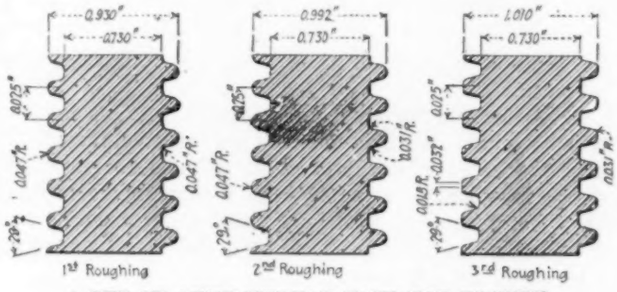
hard and continual usage. Wood, brass or aluminum boxes soon become worn or ram out of shape.

The equipment outlined in this article is based on what the average jobbing foundry prefers to work on; except in cases where continual production will warrant a match plate or a molding-machine job.

Making a Set of Roughing Taps for Acme Thread

BY ARTHUR LINDNER

One of my first problems in coming into a new job was designing a set of 1-in. four-pitch Acme thread taps for tapping the feed nuts on milling-machine



A SET OF ACME THREAD TAPS FOR BRONZE

tables. The material of which the nuts were made was tough phosphor bronze. The sketch shows the result of experiments to make a set of taps that would stand up.

After looking into the matter, I came to the conclusion that, standard taps and special steel having failed, the only thing to do was to get something new. Three roughing taps were used and a standard Acme finishing tap. We got a clean-cut thread with no seizing or binding and it seems that we entirely overcame the old trouble of breaking.

Mounts for Naval Anti-Aircraft Guns

II—The Slide and Recoil Cylinder

BY FRED H. COLVIN
Principal Associate Editor, *American Machinist*

This installment refers to the making of the slide and recoil cylinders, including the special fixtures and tools used. The boring bars are of special interest, as the boring of large holes in solid metal presents a difficult problem to most shops. The construction and assembly of the completed recoil mechanism is also of interest, simple devices being very successfully used.

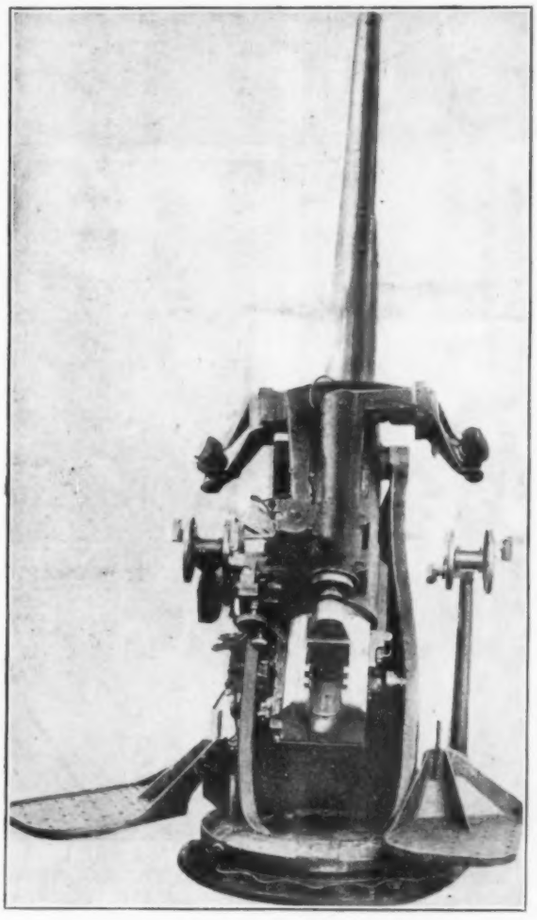
THE slide which carries the gun and through which it moves on its recoil after being fired is a heavy steel casting with trunnions which fit into the yoke at the top of the gun carriage. The first operation is rough-boring in the lathe, Fig. 19. Then comes the finish-boring, Fig. 20, this illustration giving a good idea of the kind of boring bar used for finishing.

The next operation is to cut off the ends of the trunnions to the proper length by means of milling saws on a heavy milling machine, followed by hollow-milling the trunnions under a heavy-duty drilling machine, Fig. 21, the slide being held on a mandrel and positioned by it in the V's of the fixture. This view also shows the fixture and gives an idea of the type of milling cutter. Details of the cutter are shown in Fig. 22. Hardened and ground steel strips are provided on the roughing mill to take the wear and prevent play between the body of the milling cutter and the fixture bushing.

Four milling cuts are taken by different milling cutters, the first cutter being about $3\frac{7}{32}$ in. in diameter. The body of the cutter *A* carries eight blades at its outer end as shown at *B*. Inside the recess is the end-milling cutter *C* with four blades and held in place by four screws as shown in the end view. This cutter is not used in the last operation.

Through the center of this cutter is a twist drill, this being used in preference to bringing the facing cutters into the center. This drill is held by the screw *E* and adjusted at *F*. Lubricant for the operation is introduced into the annular channel *G* from which it flows down through the hole *H* and out to the work.

Now that the trunnions are finished they become the working point for all future operations, as may be seen in Fig. 23, where the seats for the elevating arc bracket are being milled. This also utilizes the same type of mandrel as for the previous operation, but it will be observed that the trunnions are clamped in the bearing shown so as to secure alignment in both directions. There are other milling operations, but as the fixtures are of a similar nature it is unnecessary to illustrate them. Bronze liners are then fitted at each end of the slide, these forming the bearings for the sliding movement of the gun barrel during the recoil. This slide covers two diameters on the barrel, as can be seen from the illustration of the completed gun. The liners are then bored with the boring bar shown in Fig. 24.



An oil-grooving attachment, Fig. 25, is provided for this bar, with which to cut the oil grooves in the bronze liners to insure lubrication for the gun as it slides through. These grooves can be seen in Fig. 26. Fig. 24 gives all the details necessary and needs no further explanation.

The details of the grooving head, Fig. 25, are of considerable interest. The body *A* fits into the boring bar, being located by the cone-point screw and held firmly in place by the flat-pointed screw on the opposite side. The cutting tool *B* is carried in a small tool slide *C*, this being guided in the holder *D*. This angular slide is controlled by the knurled nut *E* acting on the screw shown, the distance of travel being limited by the check nuts *F*. These details may also be useful in connection with other work.

The recoil mechanism of the naval anti-aircraft gun is a combination of two coil springs, one inside the other, and an oil-controlled piston, or what might be called a hydraulic recoil with a spring return. The cylinders are bored from a solid-steel billet in a heavy engine lathe, Fig. 27, one end being held in a chuck and the other supported in the steadyrest as shown. The chuck is a substantial affair as may be seen in the illustration. It has a plain steel body and two sets of $1\frac{1}{4}$-in. setscrews for gripping the billet.

The boring of a solid-steel billet is quite a problem if time is any object, and the methods used are of special interest on that account. The first bar is what is known as a cannon drill, having a single cutting edge, Fig. 28. This shows both plain and serrated edges on the cutters. The bar is drilled for carrying a substantial stream of lubricant to the cutting edges and washing the chips back out of the way to the large right-angled groove in the bar. This bar also carries

a double-ended cutter 16 in. behind the front edge of the first cutter, the details being shown in Fig. 28. This cutter starts the large-size hole for the next bar.

Another type of boring head that has proved successful in opening up a solid billet is the one reproduced in Fig. 29, designed by the Tioga Steel and Iron Co., Philadelphia, Penn. It consists primarily of the body *A*, having a central recess *B* to receive a pilot drill as shown in detail at *C*.

The body carries four hardened and ground steel strips *F* to take the wear, as the boring head forces its way into the work. These strips are shown at *G*.

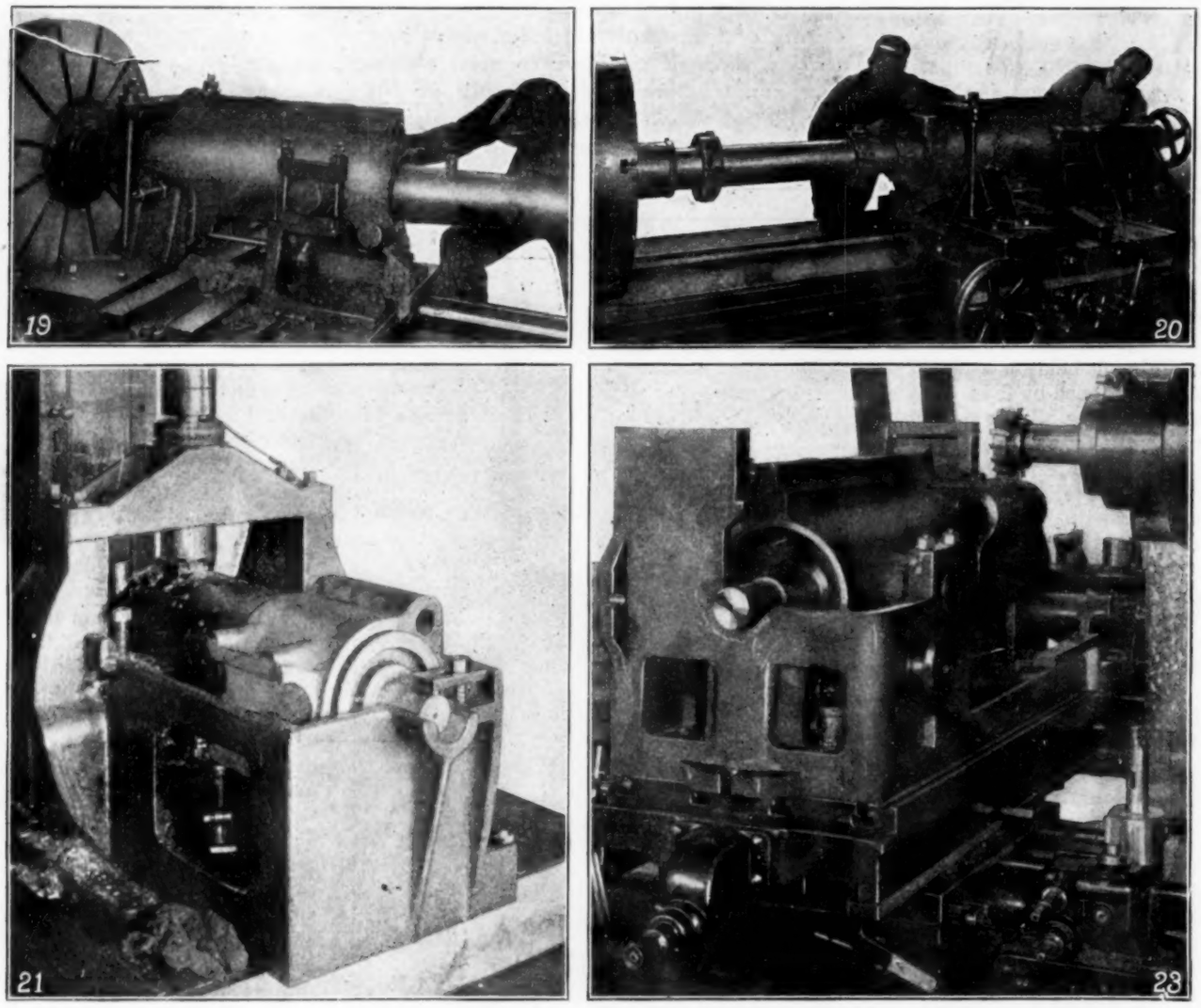
Holes for lubricant are shown at *H*, these being drilled into a large central hole so as to insure a copious supply of lubricant. The main cutters are shown in detail at *I*, and they are provided with nicks for chip-breaking in the usual way. This type of drill has given better results than the one previously shown, both in connection with these recoil cylinders and on gun work in other plants.

The outside of the cylinder is turned with three tools in a special tool block, these being so spaced as to reduce the traverse. Each tool is held in a Williams toolholder, the details of the block being shown in Fig. 30.

Inside the recoil cylinder is a bronze lining with a specially shaped port to give a graduated release opening for the oil as it flows from one side of the recoil piston to the other. One of these bronze linings is shown, together with the fixture in which it is milled, in Fig. 31.

The assembling of the recoil cylinders, Fig. 32, has several interesting features, although the apparatus is about as simple as can be devised. Each cylinder has to be hydraulically tested by the hand pump shown and must not show a bulge under the pressure applied. The cylinders are then clamped in the stand to the right of the picture and the springs inserted. The springs are at *A* and the piston and rod at *B*, while at *C* is one of the cylinders with the head in place showing the threaded connection for the gun itself.

These springs require considerable pressure to pull them into place, this being supplied by the threaded rod shown at *D*, which carries a nut by which the spring is pulled in the cylinder, the pulling rod being removed when the spring and piston are finally in



FIGS. 19, 20, 21 AND 23. OPERATIONS ON THE TRUNNIONS FOR THE SLIDE
Fig. 19—Rough-boring slide. Fig. 20—The finish cut and its boring bar. Fig. 21—Hollow-milling the trunnions. Fig. 23—Milling arc bracket seats

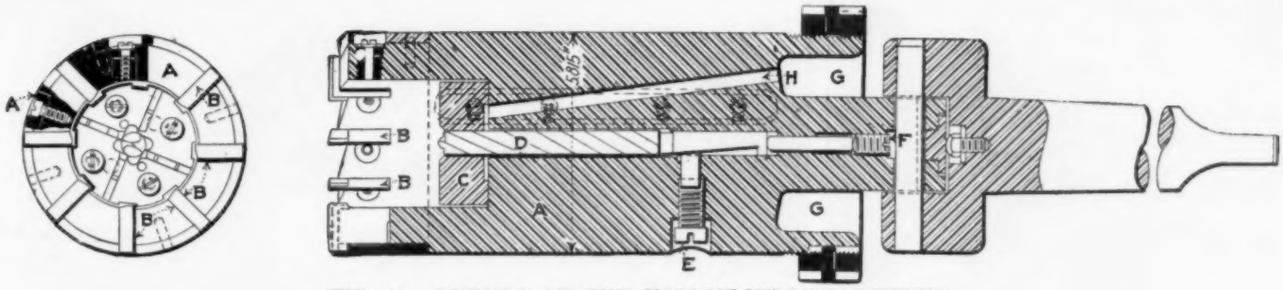


FIG. 22. DETAILS OF THE HOLLOW-MILLING CUTTERS

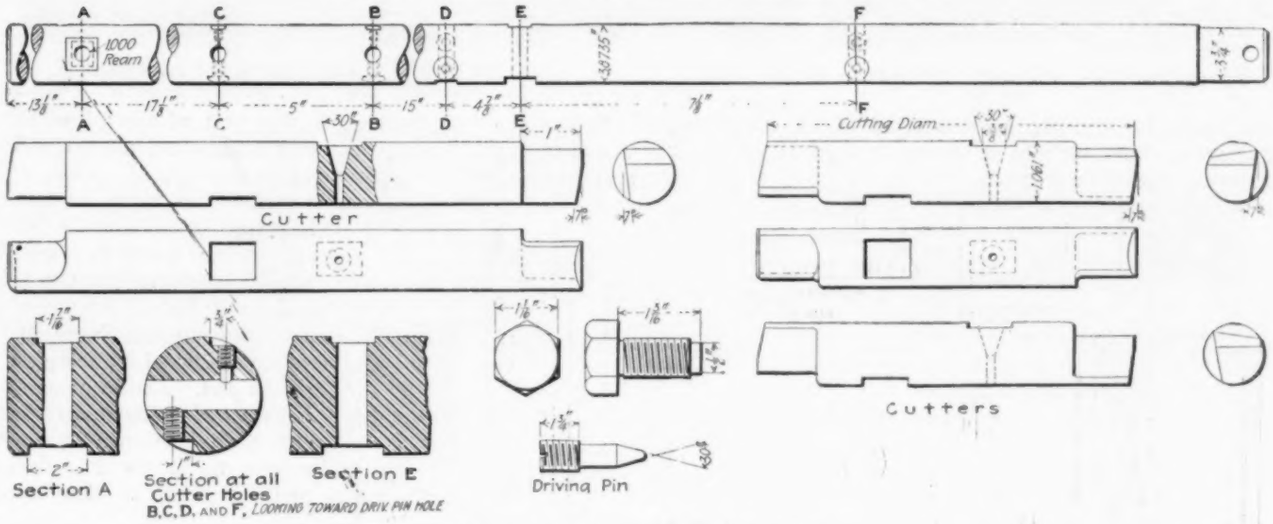


FIG. 24. BORING BAR FOR LINERS

place. Before putting the springs in position it is necessary to insert the brass liner *E* containing the gradual opening for governing the recoil. One of these bronze linings is shown, together with the fixture in which it is milled, in Fig. 31.

An idea of the assembly can be had from Fig. 33. They are now being assembled in larger lots than is indicated in this illustration.

Another milling operation, similar in some ways to

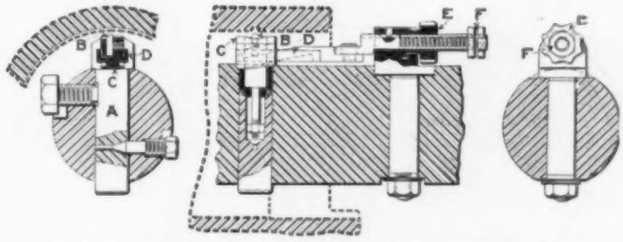


FIG. 25. OIL-GROOVING TOOL FOR BORING BAR

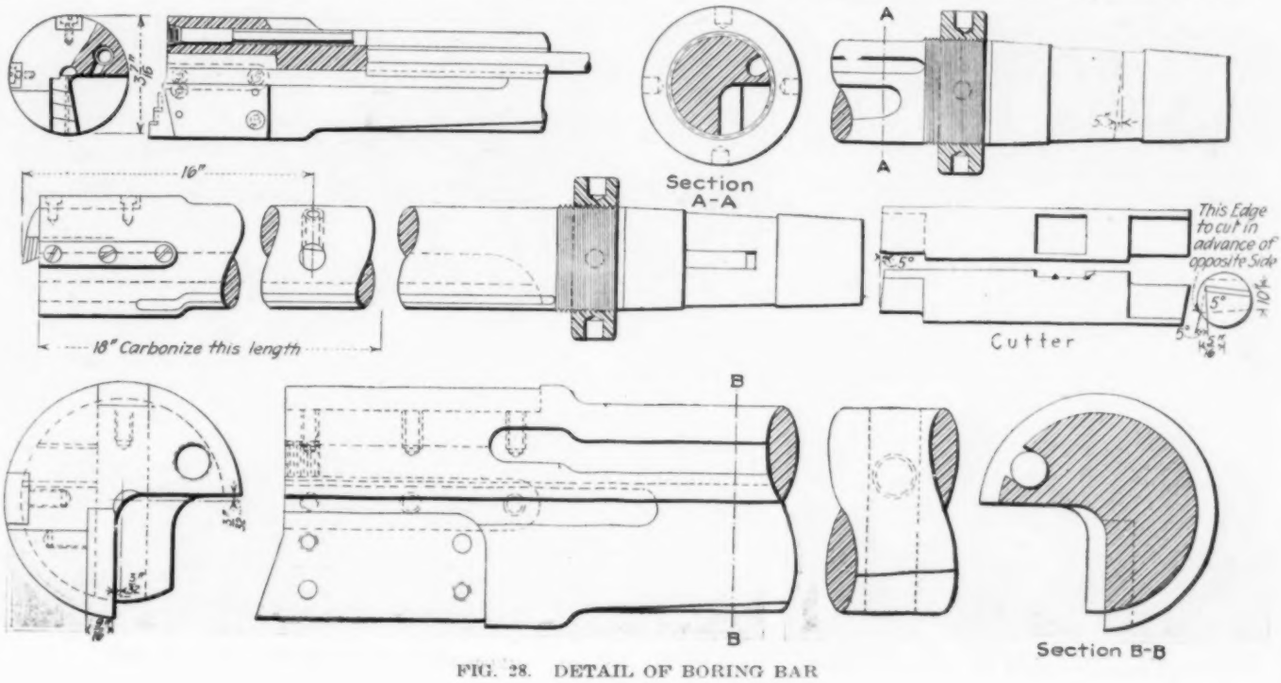


FIG. 28. DETAIL OF BORING BAR

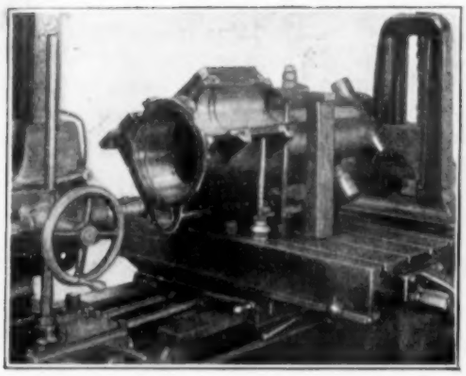


FIG. 26. BORING FOR BREECH-BLOCK MECHANISM

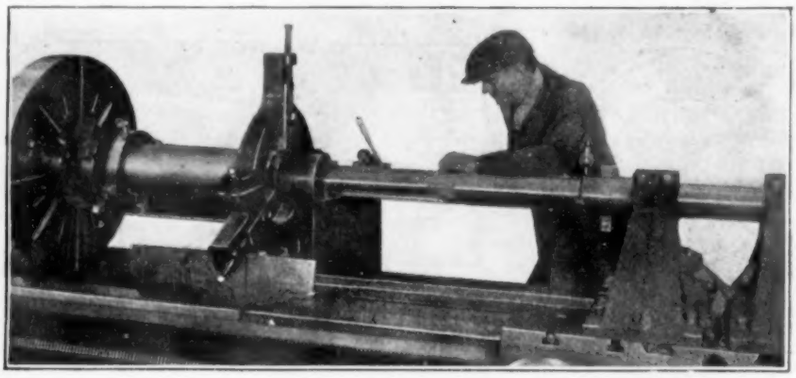


FIG. 27. BORING THE RECOIL CYLINDER

that shown in Fig. 31, is the cutting of the oil groove in the trunnion bearings as shown in Fig. 34. This is shown in detail in Fig. 35.

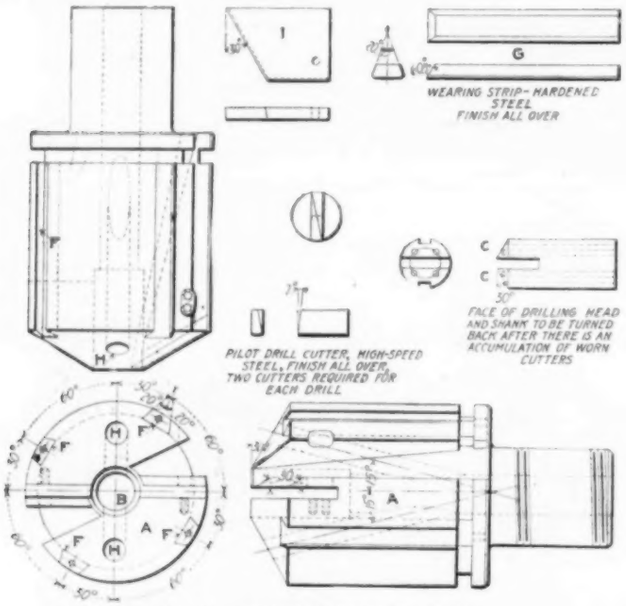

WEARING STRIP—HARDENED STEEL FINISH ALL OVER
PILOT DRILL CUTTER, HIGH-SPEED STEEL, FINISH ALL OVER, TWO CUTTERS REQUIRED FOR EACH DRILL
FACE OF DRILLING HEAD AND SHANK TO BE TURNED BACK AFTER THERE IS AN ACCUMULATION OF WORN CUTTERS

FIG. 29. BORING-BAR DETAILS

The work is held at *A* on the end of the piece *B*, which is revolved by the worm and wheel shown and also has an end movement due to the formed groove *C* and the pin *D*. The end movement is more or less balanced by means of the two springs *E* and *F*. These are separated by the cup *G* and both are in compression due to the lever *H*, which is locked by a toggle at the end. As the piece *B* is removed endwise by the cam *C* and the pin *D*, one spring tends to compress and the other to elongate,

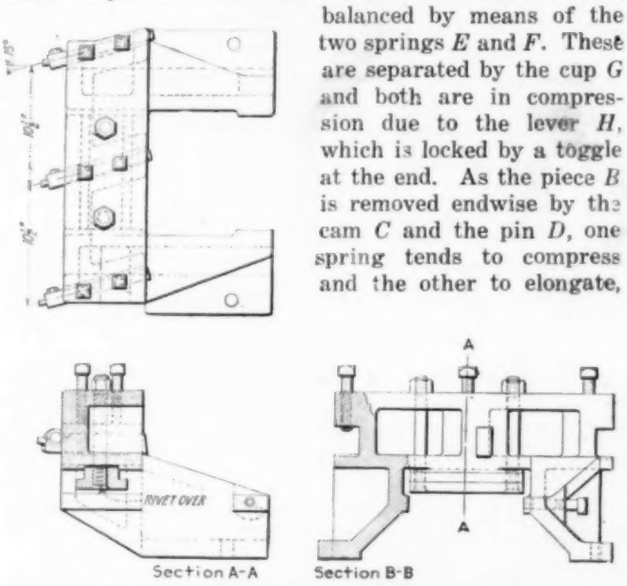


FIG. 30. TOOL BLOCK FOR TURNING CYLINDER

FIG. 31. MILLING PORT IN BRONZE LINER

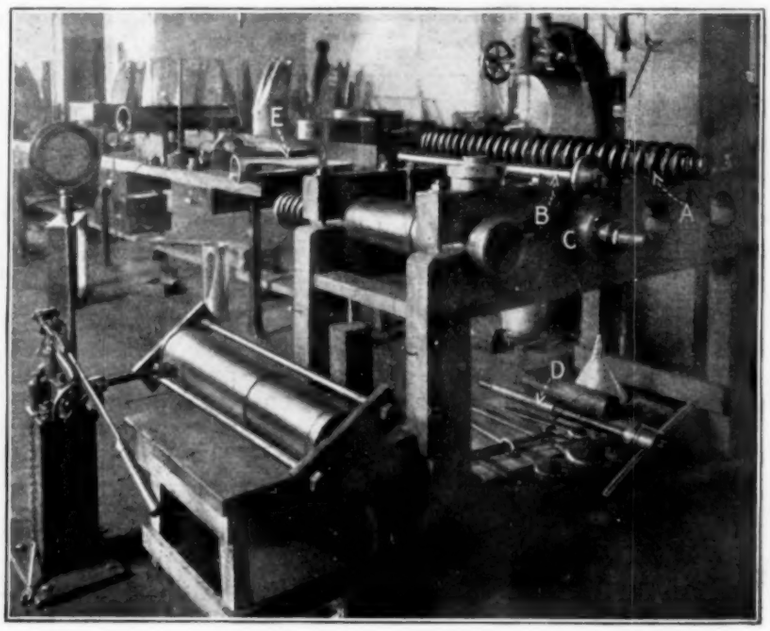


FIG. 32. ASSEMBLING THE RECOIL CYLINDER

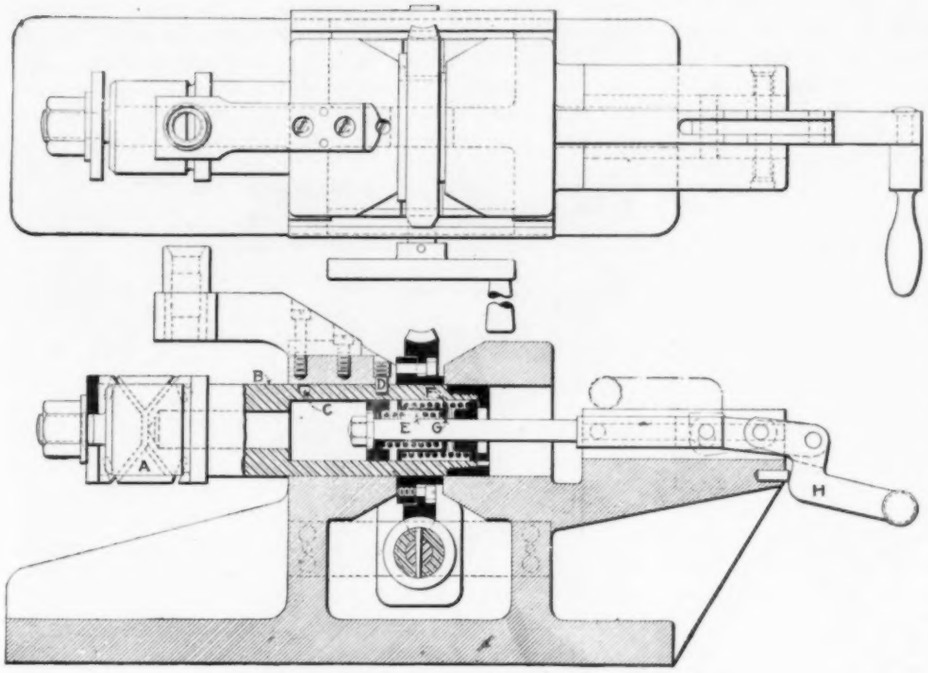


FIG. 35. DETAILS OF GROOVING FIXTURE

but this tendency is equalized by the cup *G* which floats between them. This device is satisfactory in taking up all lost motion between the groove and the pin.

Making Difficult Duplicate Gages

BY E. A. DIXIE

Mr. Munson on page 1245, Vol. 50, objects to the way I made those gages and he then goes on to tell his reasons, one of which is: "the uncertainty of any measurement dependent upon an absolutely sharp edge."

I do not know where he got the idea that I depended on a sharp edge to get my measurements. As stated in the article, I ground up a hollow cylinder to a certain diameter, measuring over the perimeter of the cylinder and not over the edge. The grinding machine was then set to grind the bore to a certain angle. This, of course, produced a sharp edge where the conical bore ran out to and crossed the perimeter of the cylinder. No measurement was taken from this sharp edge as no measurement therefrom was necessary. The outside diameter of the cylinder was the only measurement taken and the angular bore was controlled by the angular accuracy of the grinding machine which was found to be accurate enough. The "light shrink fit" was merely enough to keep the two parts of the master gage from being displaced when the gages were being tried with the prussian blue. I did not take the temperature to which the outer member was heated, but guess it to have been about 150 deg. F. The inner part was about the temperature of the atmosphere, about 90 deg. F. At these temperatures the pieces went together very easily and the sharp edge of the inner member rested firmly on the surface plate upon which the two were assembled.

I cannot agree with Mr. Munson's "better way." I made one master gage which checked up the work so accurately that it passed inspection; that is all that any gage is supposed to do. In making this one master gage I encountered only one set of chances for the introduction of errors. Mr. Munson proposes making two master gages in order to get one master gage; running twice the chance that I did of introducing errors into the work. I would like Mr. Munson to tell exactly how he would

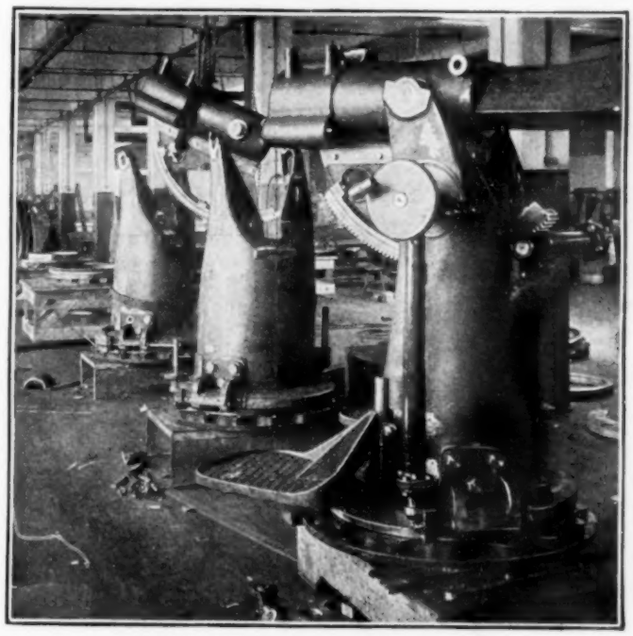


FIG. 33. ASSEMBLY OF MOUNTS

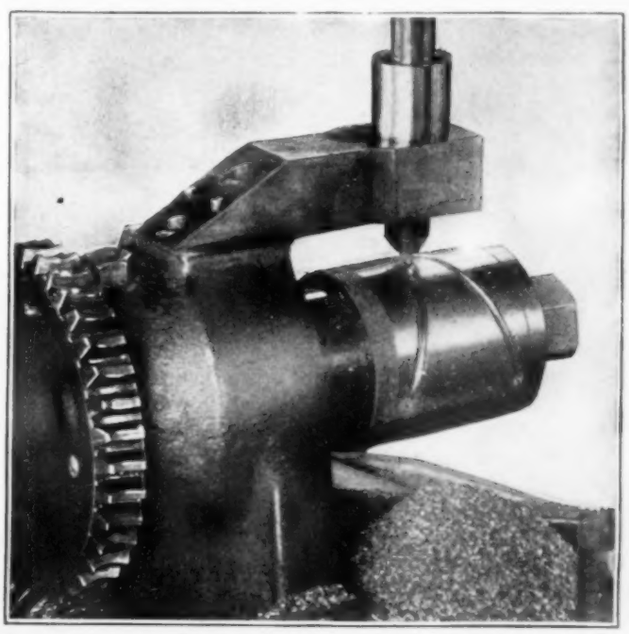


FIG. 34. MILLING OIL GROOVES IN TRUNNION BEARING

go about making the cone shown on the sine-bar fixture in his Fig. 1, and also, supposing he did not get it exactly right the first time, how he gets it back in the grinding machine so that it runs exactly true? So far as I can gather from his description and the illustrations, he is the one who is figuring on measuring over sharp edges which he deprecates so much. If not, how does he measure the base diameter of the cone in Fig. 1?

In Hindoo mythology there is a deity called, I think, Vishnu, who had seven pairs of hands. Making the measurement (accurately) shown in Mr. Munson's Fig. 2 would, I think, be no cinch even for this Vishnu person. Just think of being sure that the two cylindrical plugs are against the plane surface touching the cone, and exactly parallel to each other. Here are three essentials to accurate measurement which will keep three pairs of hands fully occupied. Two more hands, one pair, can be used to hold and adjust the micrometer, one hand can be employed in noting down the size, while with the left hand of his pair, Vishnu could scratch his head while he wonders whether he has not overlooked something.

So without further information on his methods, I cannot agree with Mr. Munson that they are better than mine. However, I am open to conviction.

An Unusual Boring Mill Operation

BY M. E. HOAG

An unusual boring-mill operation was successfully handled in the shops of the W. A. Jones Foundry and Machine Co., of Chicago, by means of a rather simple tool designed by the superintendent of the machine shop. The pieces to be machined were tire vulcanizers,

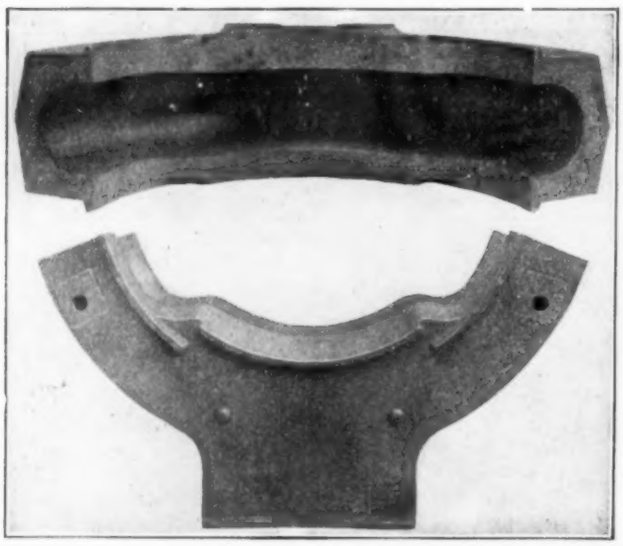


FIG. 1. TIRE VULCANIZER MOLD

top and side views of which are shown in Fig. 1, and were to be used for re-treading automobile tires. These pieces were cast with hollow walls and involved some nice core and molding work, for they had to pass a cold-water test of 25 lb. per sq.in., and consequently had to be of even thickness and free from blowholes.

The machine set-up with two pieces in place is shown in Fig. 2. This figure also shows the toolhead *A* in position for making a straight undercut extending 4 in. in from the upper edge of the piece, at which point the radius begins. This radius, which is $2\frac{13}{16}$ in., has to be held fairly close to size and finished smoothly in order to give a good appearance to the tire. The toolholder *B*, Fig. 2, is shown to a larger scale at *A*, Fig. 3. The body of the tool *B* is bored to receive the toolholder *C*, which is clamped down on the Stellite tools *DD*, these tools being further held in position by setscrews. The holder *C* is free to rotate in the body *B*,

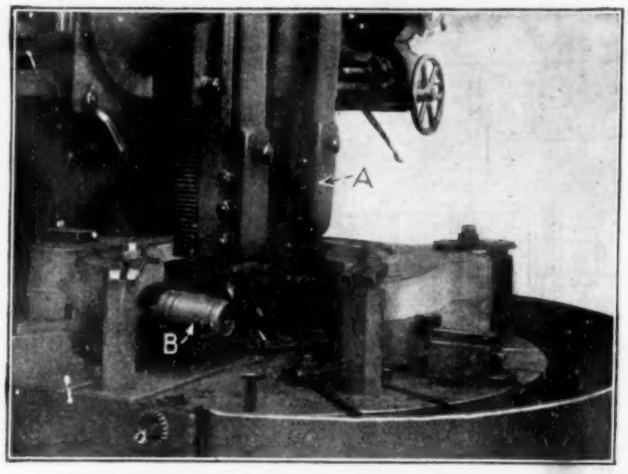


FIG. 2. BORING MILL SET-UP FOR MACHINING CURVED RECESS

and is driven through a worm gear on the shaft *E*, by a worm shaft on the outer end of which is attached the star wheel *F*. This worm shaft passes through suitable bearings in the under side of the holder *G*. The plate *H* is fastened to the faceplate of the boring mill and is provided with holes suitably located to receive two pins in the block *I*. Each complete revolution of the faceplate serves to index the star wheel one

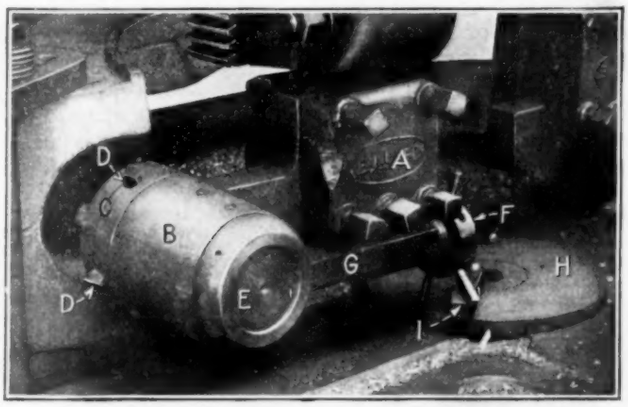


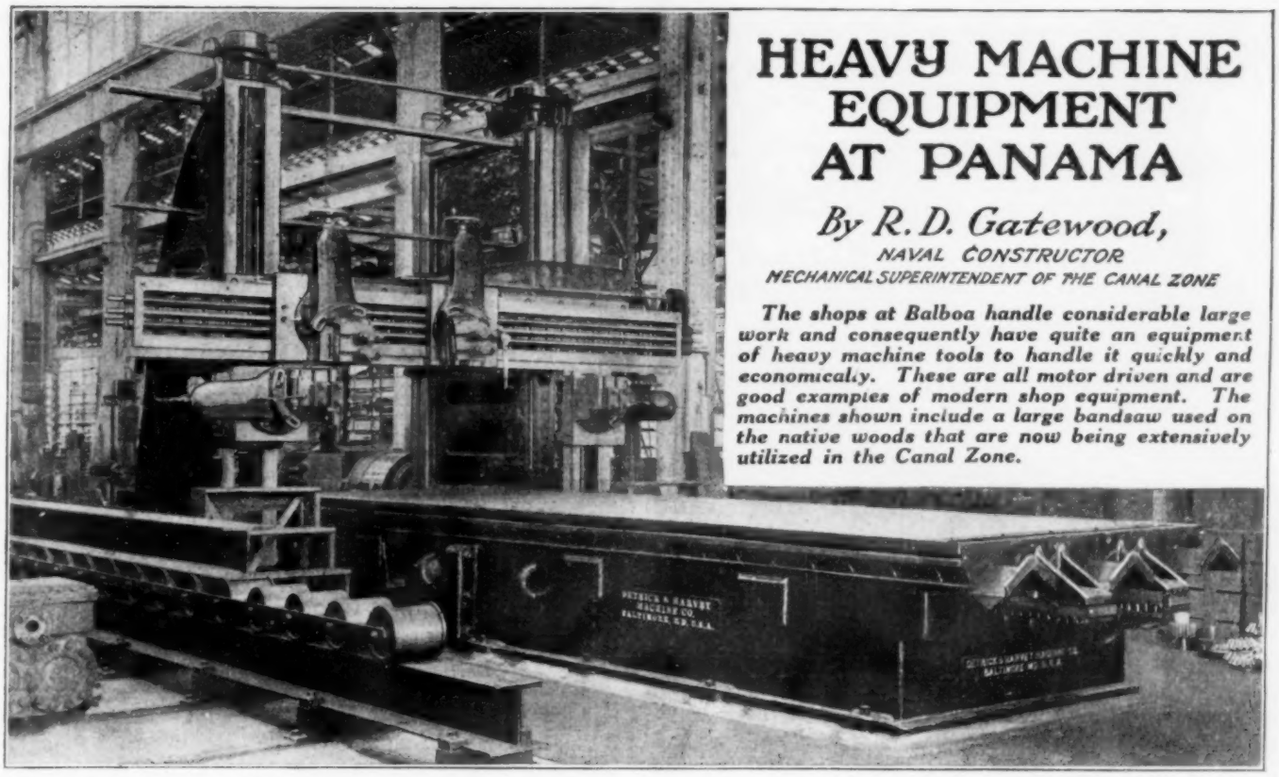
FIG. 3. CLOSE-UP VIEW OF TOOL ARRANGEMENT

point as it comes in contact with the block *I*, turning the toolholder and tools around a short distance and thus producing a smooth finish with perfect radius.

As stated above Stellite tools were used for this work, two roughing and one finishing cut being taken to complete the piece.

Severe Tests of Diesel Engines

The German submarines which were allotted to the Japanese Navy recently arrived in Japan after a voyage of over 10,000 miles under their own power. It is understood that almost no difficulty was encountered on the voyage which speaks volumes for the durability of the Diesel engine as built for the Germany Navy.



HEAVY MACHINE EQUIPMENT AT PANAMA

By R. D. Gatewood,
NAVAL CONSTRUCTOR
MECHANICAL SUPERINTENDENT OF THE CANAL ZONE

The shops at Balboa handle considerable large work and consequently have quite an equipment of heavy machine tools to handle it quickly and economically. These are all motor driven and are good examples of modern shop equipment. The machines shown include a large bandsaw used on the native woods that are now being extensively utilized in the Canal Zone.

THE largest planing machine in the machine shop at Balboa, Canal Zone, is an open-side Detrick & Harvey machine and is shown in the headpiece. It will handle work 96 in. high by 132 in. wide by 24 ft. long. The machine is motor driven and has a 65-hp. motor for the main drive and a 7½-hp. motor for raising and lowering the cross-rail, both of which operate on 220-volt direct current.

The machine has two housings, one of which can be removed when the work is wider than 132 in. When work is of such size that the machine must be operated open sided the overhanging portion which extends beyond the bed of the machine is supported on rollers which run on a track parallel to the machine. This track can be adjusted toward or away from the bed to handle the varying overhangs of the work. There are four tool heads, two on the cross-rail and one on each housing, so that the machine can operate on the top and two sides of work up to 132 in. in width and on the top and one side of wider work.

The main drive is of the standard reversing-motor type with two shafts direct geared to the motor, which is reversed through a master switch mechanically connected to a trip actuated by dogs on the table. The planing machine has cutting speeds varying from 15 ft. to 25 ft. per minute and feeds as follows: Cross-rail, horizontal, $\frac{1}{16}$ in. to 1 in.; vertical, $\frac{1}{16}$ in. to 1 in.; side rails, vertical, $\frac{1}{16}$ in. to 1 in. The feeds are operated by the main driving motor through a positive friction device.

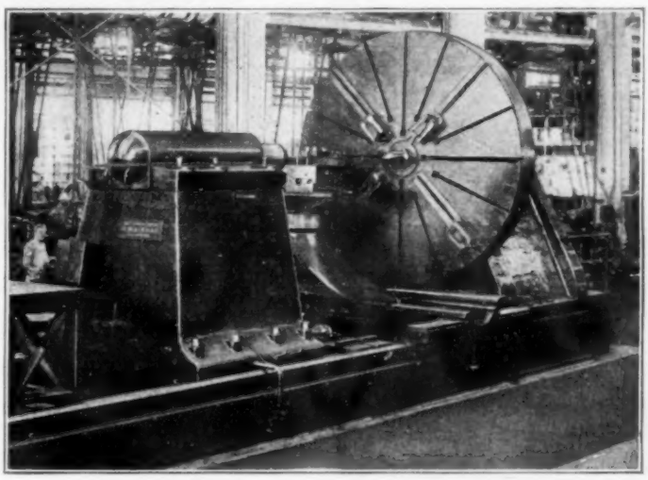


FIG. 1. LATHE FOR BATTLESHIP CRANKSHAFTS

The largest lathe in the plant, Fig. 1, is manufactured by the Niles-Bement-Pond Co., motor driven and capable of swinging 156 in. diameter over ways, 115 in. diameter over carriage and 65 ft. between centers. The machine is operated by two 220-volt direct-current motors, one 40 hp. for the spindle drive and one 3 hp. for carriage traverse.

The lathe has a speed range from ¾ r.p.m. to 29 r.p.m. and all necessary variations of feeds for work for which it is suited. It is also equipped to cut all threads which are likely to be required. It is equipped with a 10-ft. faceplate, five steadyrests capable of taking work up to 30 in. in diameter, a 6-ft. taper attachment and a hand-power screw jack for use in straightening shafting.

The plate-bending rolls installed in the boiler shop have a capacity of bending plates ¾ in. thick by 30 ft. long, 1 in. thick by 24 ft. long, or 2 in. thick by 6 ft. long. This is shown in Fig. 2. The lower rolls are operated by a 75-hp. motor operating at 750 r.p.m. The motor for raising and lowering the upper roll is a 22-hp. motor operating at 750 r.p.m.

This has proved a big time saver in bending plates for ship work and boiler shells, and has given excellent service in connection with several large repair jobs to the bottoms of damaged vessels.

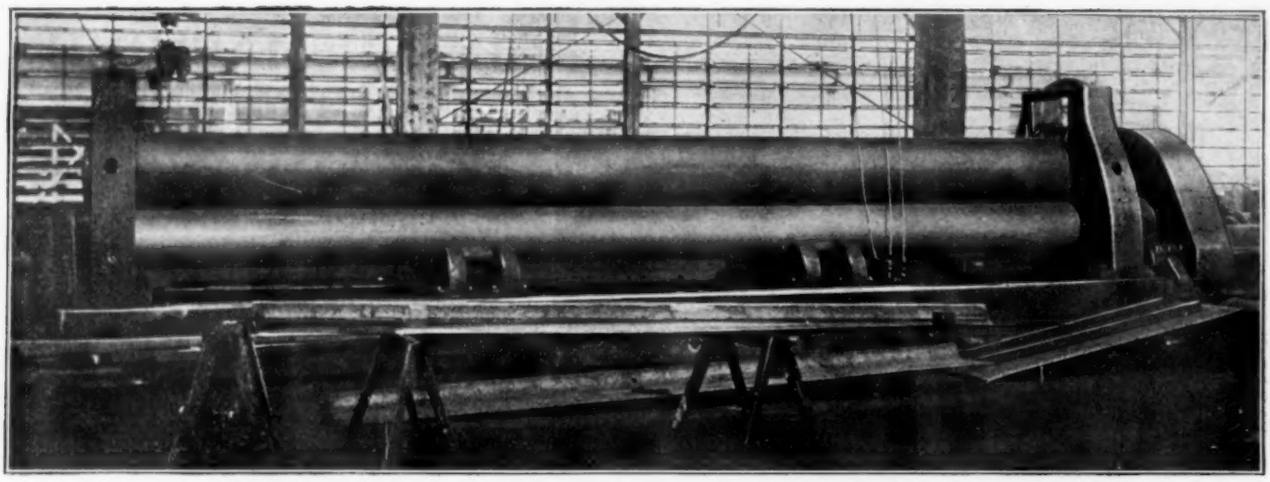


FIG. 2. BATTLESHIP PLATE-BENDING ROLLS

There has recently been installed in the boiler shop the plate planing machine shown in Fig. 3. The plate is clamped in position by means of 10 air-operated cylinders. The carriage carrying the cutting tools along the edge of the plate is operated by a 40-hp. reversible motor and carries three tools, two of which are mounted on a tool block and arranged for cutting both ways of the stroke. The third tool is mounted on a swivel block, with a feed in two directions, for beveling the edges of the plate. The machine can cut a square or a bevel edge on plates as large as 1¼ in. thick by 32 ft. long.

Band-Saw Mill

The saw mill, Fig. 4, installed in the wood-working shop, is used principally for cutting native timber into lumber. Over 4,000,000 ft. of lumber has been sawed with this mill in the past year. As much as 10,000 ft. b.m. of native hardwood has been cut from the log in a working day of eight hours. This mill is of the band-saw type, with a carriage having a total length of 60 ft. divided in three sections of 20 ft. each. The saw is 10 in. wide by 36 ft. 6 in. long, running over wheels of 72 in. in diameter. The saw can make a center cut on a log of 42 in. in diameter and can break down a log 60 in. in diameter. A 150-hp. motor operates the saw at a speed of 8000 ft. per minute. The carriage, by means of a rope drive, runs the timber through the saw at a rate of 110 ft. per minute, returning at a rate of 300 ft. per minute.

As most of the native timber is hardwood of excessive weight, running as high as 100 lb. per cubic foot, it can be readily seen that the turning of the log is an important feature. To accomplish this speedily and with a minimum of labor an overhead log-turning device operated by a 15-hp. motor is installed in front of the saw and over the carriage. As the lumber is cut the carriage delivers it to a cutoff for squaring off the ends of the lumber.

To keep the saws in working condition a band-saw sharpening outfit is installed above the sawmill outfit. The sharpening of the saws is accomplished automatically, power being furnished by a 7½-hp. motor operating at 1500 r.p.m.

The Electrical Equipment

Four types of motors were adopted for power drives; direct-current, commutating-pole, variable-speed motors; slip-ring induction motors; squirrel-cage induction motors, and synchronous motors. Direct-current motors operate on 220-volt current and alternating

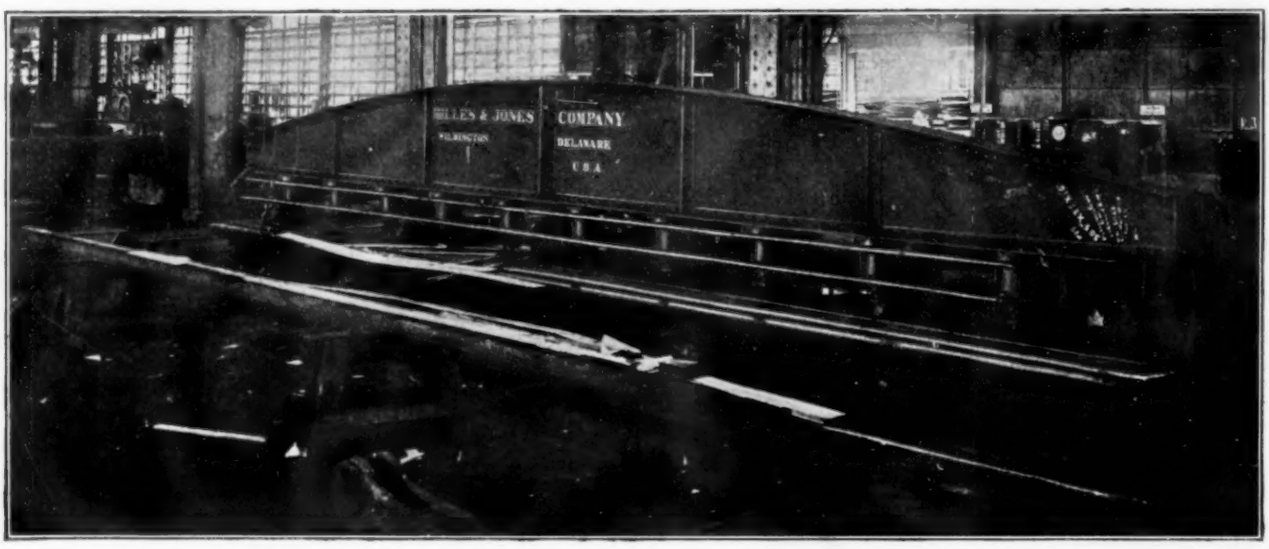


FIG. 3. A 32-FT. PLATE PLANING MACHINE

current motors on 220-volt, three-phase, 25-cycle current. The direct-current motors drive lathes, planing machines, boring machines, milling machines and other tools where a variable tool speed is desired. They have speed ranges from 350 to 1400 r.p.m., 375 to 1125, 375 to 1500, 450 to 1800, and 500 to 1500. The slip-ring, polar-wound rotor inductor motors drive machines that require a high starting torque or that are necessarily reversible, e.g., bending rolls, low-pressure blowers, the 2-ton Tropenas converter and the transfer table.

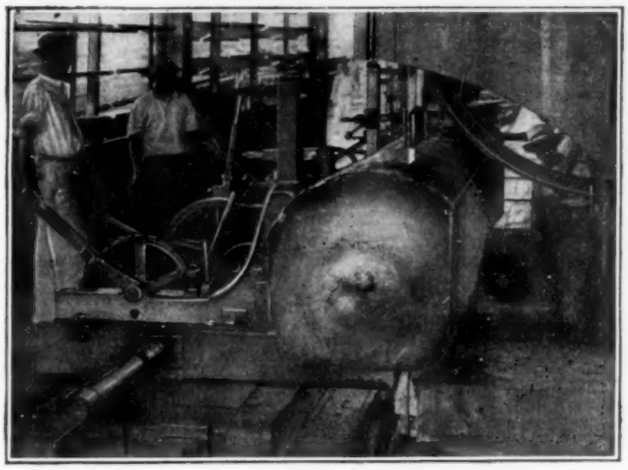


FIG. 4. A 150-HP. BAND SAW

The squirrel-cage induction motors are used for all group drives and all constant-speed machines. The synchronous motors are used for driving direct-current generators and air compressors, and are arranged for operation at 75 per cent. loading power factor for correcting the load factor of the plant. All motors were purchased under specifications calling for specially developed insulation similar to that used on the lock-machinery motors.

Shop Lighting

Lighting for the shops is obtained from tungsten filament lamps and general illumination is used throughout. This method was considered preferable to special intensified illumination at each machine or in particular sections of the shop, on account of the fact that as all points received approximately the same amount of light no change in wiring or the position of lamps is required if the arrangement of machines is changed. Lighting is all on 110-220-volt, single-phase circuits. Feeders run from the lighting transformers to panel boxes located at convenient points throughout the shop, and from these boxes the lights in the individual sections are controlled.

Branch circuits are designed for a maximum load of 3000 watts, with a drop of three volts. All wiring is carried in conduits attached to the roof trusses and columns, and drops are run down the columns to plug receptacles for extension lamps. Lamps themselves are 100 watt, 150 watt, 250 watt and 500 watt, depending on their location and the intensity of illumination desired. The machine and erecting shop, for example, has a total floor space of 67,789 sq.ft. and has a calculated illumination in a plan 3 ft. above the floor of 7.6-ft. candles in the machine shop, 8.37-ft. candles in the tool department and 7.75-ft. candles in the erecting shop—this with a total of 120,425 watts in lamps.

More About Discoloration of Finished Surfaces by Oil

By S. A. Inscoe,
Wolverhampton, England

The paragraph on page 802, Vol. 50 of *American Machinist* regarding the discoloration of finished machine surfaces by oil, opens up a subject which, while being of deep interest to the engineer and machinist, is really within the sphere of industrial chemistry and can be satisfactorily solved only by chemists acquainted with the properties of oils, fats and greases, and the manner in which they are acted upon by the atmosphere; for, even by those unacquainted with chemistry, it will be observed that the discoloration is evidently a slight and ever-increasing corrosion, either caused or accelerated by the oil or grease used as a protective agent.

Certain kinds of oils and gases are well known to lose their original properties through heat, evaporation, or chemical action upon being exposed to the atmosphere. Tallow, fat, oil or grease, especially animal fats, soon undergo change and allow, or even assist, the process of corrosion.

Thin mineral oil is entirely unsuited to protective purposes as it so easily flows to the lowest point and so quickly evaporates.

The finished surface should be as nearly perfectly clean and dry as possible. Small articles should be dipped in or wiped over with a hot solution of soda and large articles cleaned with some volatile spirit; after which they should be slushed over with petroleum jelly of a commercially pure quality. Other methods are to apply warm a mixture of white lead and tallow or a mixture of linseed oil and turpentine.

Machined surfaces which are exposed to the atmosphere during transit or to action of the moist sea air or salt water should be painted over with a colorless japan lacquer or varnish, which can be easily removed when necessary, and of which there are several kinds on the market. For small tools stocked by merchants or stored in tool cribs, petroleum jelly of a good grade and a wrapping of grease-proof paper should be provided; or there is on the market a grease specially suitable known as "Cosmolubric" oil.

This discoloration has long been a bug-bear to toolmakers and many experiments have been made in order to overcome it but without complete success, and the real solution must in the end be left to the industrial chemist to whom must be given the task of producing an oil or grease impervious to atmospheric influence, heavy enough not to flow, non-volatile, easily removable, and cheap.

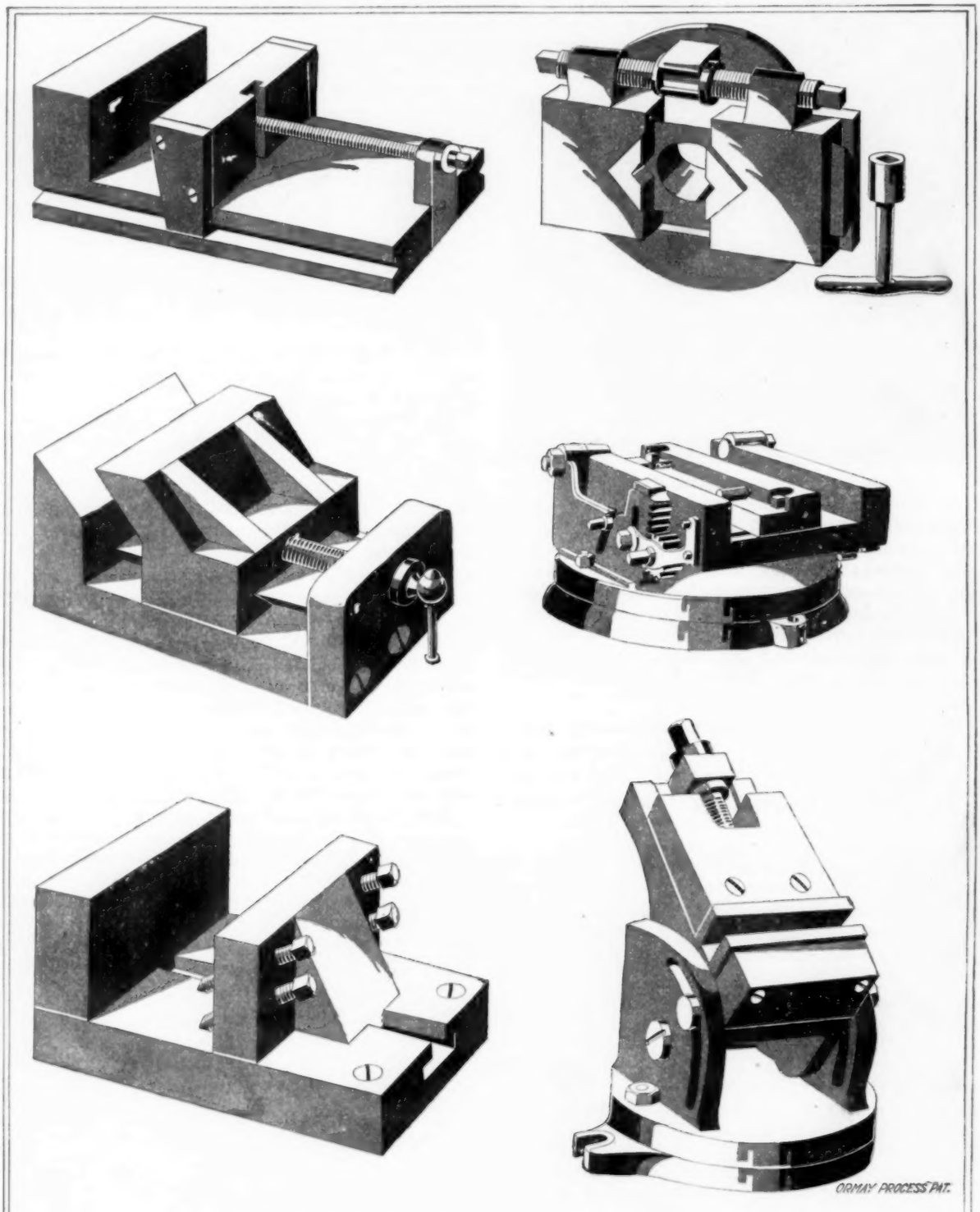
A Milling-Machine Kink

By A. R. Durant

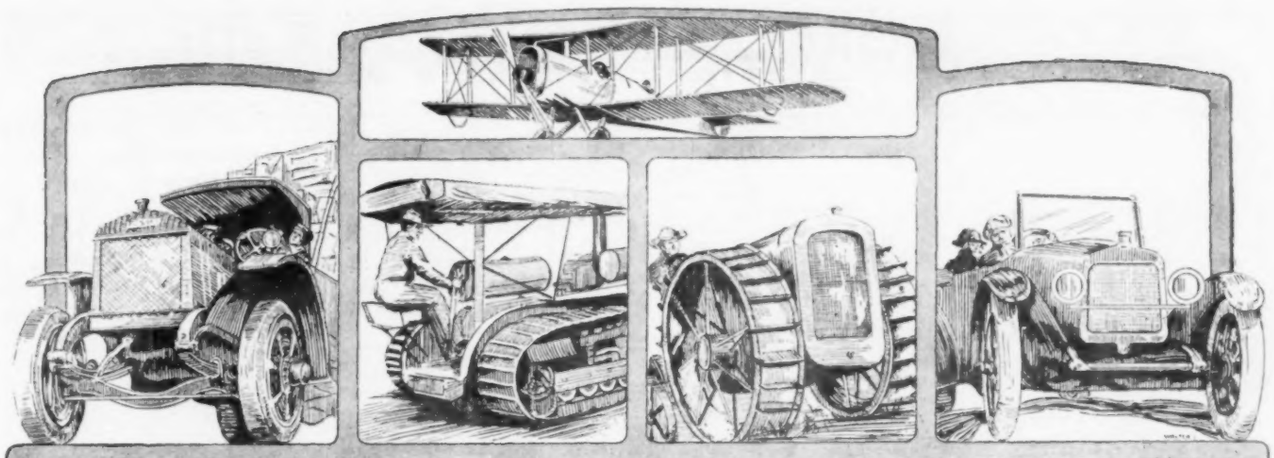
While indexing a long shaft, held between centers on a milling machine, some difficulty was encountered in operating the longitudinal feed. The length of the shaft necessitated moving the dividing head beyond its normal position so that it overhung the end of the table and interfered with the motion of the feed handle. The handle, which was held by a key and nut, was removed and a carpenters' brace attached by placing the chuck over the end of the feed screw and tightening it with a pipe wrench. The table could then be moved back and forth by turning the brace.

FOR SMALL SHOPS *and* ALL SHOPS

By J. A. Lucas



VARIOUS METHODS OF HOLDING WORK



Connecting-Rods for Motor Trucks and Passenger Cars

By FRED H. COLVIN
Principal Associate Editor, *American Machinist*

Here again a concentration of machines eliminates the handling of material and convenient fixtures reduce the loss of the cutting time. This shop was one of the first to use broaching machines for rod work and has found it very satisfactory.

THE methods of machining the connecting-rods for the Locomobile passenger car and the Riker truck are very efficient and the fixtures contain suggestions for other work of a similar kind. The operations on the connecting-rods are as follows:

Blocking out the forging, 8 per hour.
Pickling the forging, 15 per hour.
Heat-treating.
Sandblasting, 30 per hour.
Snagging, 28 per hour.
Straightening to gage from milling fixture, 20 per hour.
Rough-drilling both ends, 17 per hour.
Straddle-milling both arms, 11 per hour.
Bore for broaching, 16 per hour.
Broaching both holes, 30 per hour.
Hollow-milling and burring both ends, 15 per hour.
Milling the sides of the web, 5 per hour.
Milling the tops of the channels, 4 per hour.
Finish-milling the channel on both sides, 5 per hour.
Profiling the wristpin boss, 22 per hour.
Form-milling the end of the crankpin cap, 18 per hour.
Mill-beveling on the oil-scoop boss, 40 per hour.
Form-milling bolt bosses, 17 per hour.
Burring, 15 per hour.
Drilling and reaming the bolt holes, 10 per hour.
Drilling and countersinking the oil holes in the crankpin ends, 32 per hour.
Gang-milling the bolt boss ends and slot, 14 per hour.

The first operation is the rough-drilling of the two ends of the rod shown in Fig. 1. No attempt is made in this operation to secure the exact center distance, the drills being allowed to follow the depressions left by the forging dies. The only locating influence is the position of the spindles. The drilling fixtures are extremely simple, consisting of a plate *A*, studs *B* and *C*, which simply prevent the connecting-rod from turning under the action of the drills, and the open-ended strap *D*, which is pushed over the rod being drilled and around the bolts *E* and *F*. This strap simply prevents the connecting-rod from lifting over the pins and is only used as a precaution against the rod being raised when the drill spindles are removed.

After the rough-drilling comes the straddle-milling of the ends of the rod, this being done in a special fixture on a horizontal milling machine, as shown in Fig. 2. The rod is centered by the arm *A* which carries a V-groove that fits over the connecting-rod bolt boss, while a similar V on the face of the fixture holds

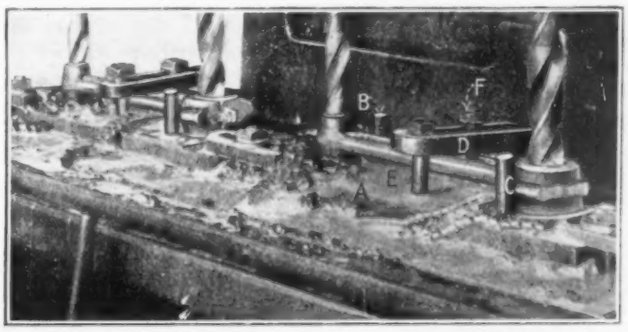


FIG. 1. ROUGH-DRILLING THE CONNECTING-RODS

the other side. The clamp *B* holds the piston end of the rod in the V-block *C*, and supports it firmly.

Large milling cutters, equipped with O.K. forged cutting tools, are used for this work, these being plainly shown in Fig. 2. These milling cutters are giving excellent satisfaction in this work, as can be seen from the operation time given in the list. The illustration also shows two gangs of milling cutters on the arbor, each pair being spaced for the proper length of each end of the connecting-rod. The fixture, shown in detail in Fig. 3, consists of two parts, the base *A* and the upper portion *B* which carries the clamps and seats. The

AUTOMOTIVE CONSTRUCTION

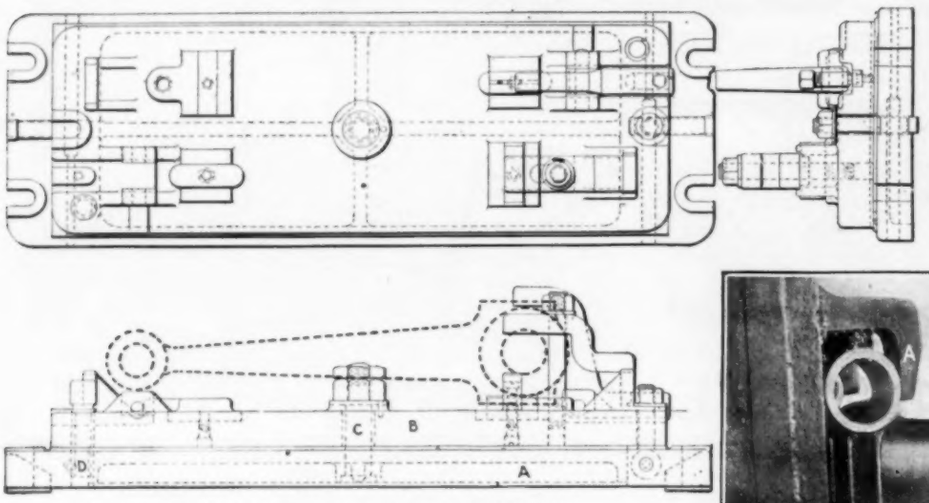


FIG. 3. DETAILS OF THE MILLING FIXTURE

part *B* can be revolved on *A* around the central pin *C* and is located in each position by the index pin *D*. After the two rods are milled on one end, the fixture is reversed and the opposite ends milled by the same gang of cutters.

The rod is now ready to be finish-bored, and this is done in the fixture shown in Fig. 4. The boring of the rods to insure proper center distance and to prepare them for being finished by the broaching operation is performed in the fixture, Fig. 4. The rod to be bored is placed in the position shown by the the dotted line, and the lever *G* whose ends act as cams against the bosses on each end of the connecting-rod, is wung into position to center the rod with reference to the bushings which guide the boring bars. The handles *A* and *B* then close the jaws on the side of the rod by means of right- and left-hand threaded screws *C* and *D*. These act against the clamps *EE* on the small end of rod, and the wedges *FF* at the large end hold the rod firmly against the bushing. *H* and *I* show sections of two of the bushings used.

The bores of the rod ends are finished by broaching, as shown in Fig. 5. This machine carries two broaches, one for each end, so that a complete rod is finished at each pass. The fixture was originally made to support the rod on the studs shown, but this has been found to be unnecessary. It will also be noted that the outer ends of the broaches are supported in a carriage which slides on an extension to the broaching machine so as to avoid all tendencies of the broaches to sag. As another precaution, every third tooth of the broach is blank to act as a guide and to help size the hole as it passes through.

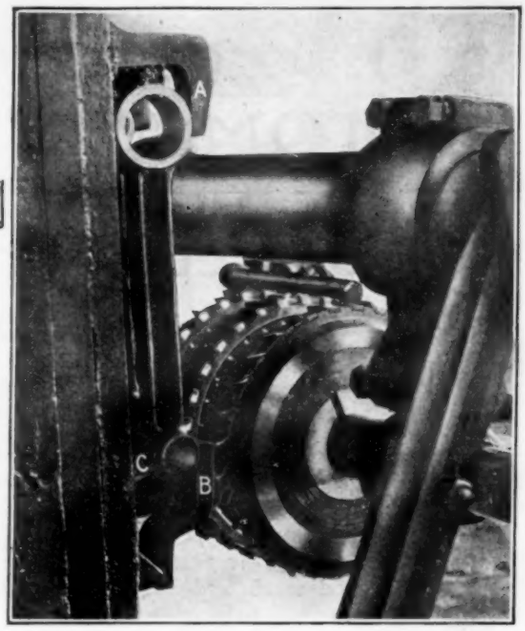


FIG. 2. STRADDLE-MILLING THE ROD ENDS

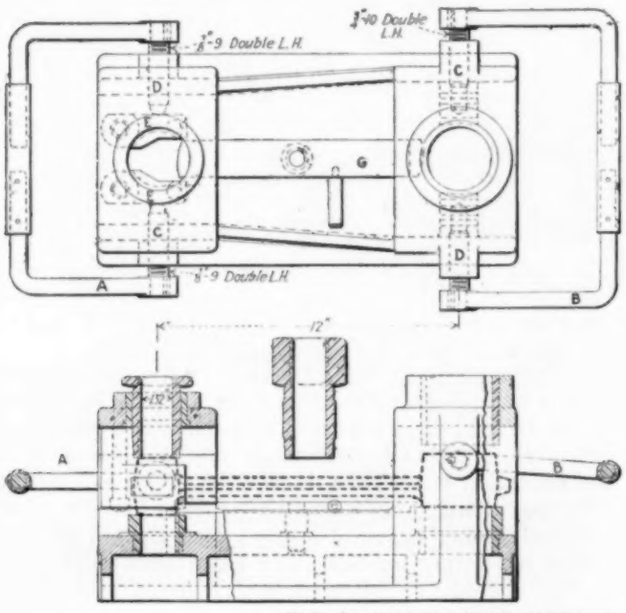
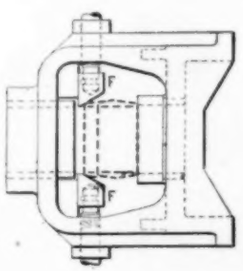
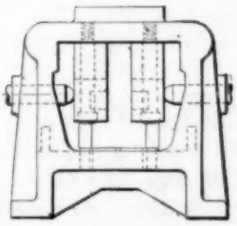


FIG. 4. ROD-BORING FIXTURE





The rods then go to the machine shown in Fig. 6, where the outside of the boss on each end is turned off with the hollow milling cutter shown in detail in Fig. 7. Each end of the rod fits over a hollow stud, the hole in the center of the stud guiding the pilot on the hollow milling cutter, details of this being shown in Fig. 7. The rods are prevented from lifting by the small cross strap shown at *A*, Fig. 6. The tool *B* is for lifting

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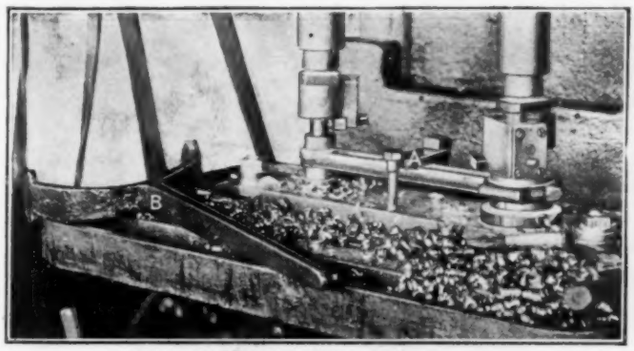

FIG. 6. HOLLOW-MILLING THE ROD ENDS

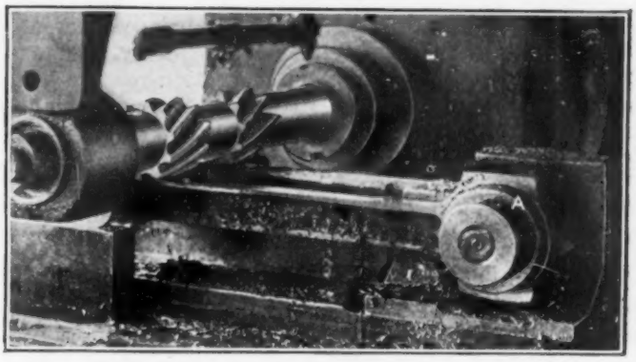

FIG. 8. MILLING THE TOPS OF THE ROD

the connecting-rod off the stud in the fixture, the hook ends sliding into the channel on the under side of the rod, when any downward movement at the end of the handle pries the rod off the stud. This is made double so that it can be used either side up, avoiding all loss of time. The main feature of the

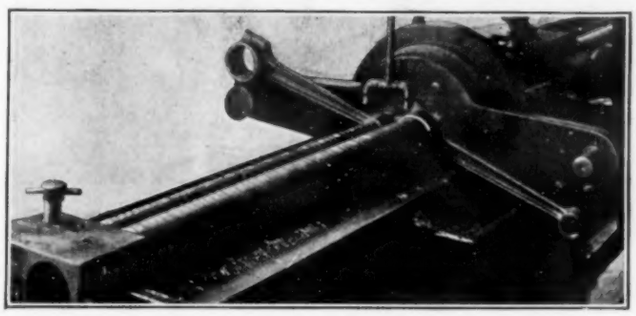

FIG. 5. BROACHING THE CONNECTING-RODS

hollow-milling tool, Fig. 7, is the cutting tool itself and the angle at which it is held. As can be seen, this has a 10-deg. rake in both directions and is so positioned with relation to the axis of the pilot as to give a shearing cut, thus removing the metal with little power.

Fig. 8 shows the milling of the top of the channels, the fixture carrying two rods, one on each side of a central web. The rods are held by the large end as shown at *A*, while pins through the small ends rest on parallel blocks to support the connecting-rods in their proper positions. A somewhat different fixture is shown in Fig. 9. This fixture holds a pair of rods while the large ends are sawed off to form the straps which hold the bearing brasses in place. This operation usually follows the milling of the channels on each side.

Fig. 10 shows the method of correcting the rod for

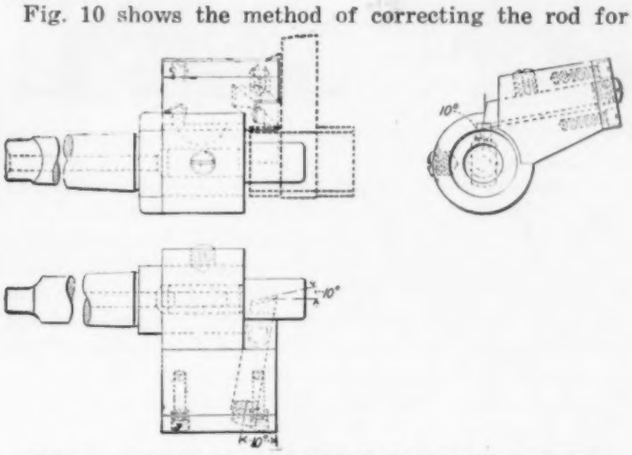

FIG. 7. DETAILS OF THE HOLLOW-MILLING CUTTER

errors in alignment, and this is done by slipping the large end over a substantial shaft, inserting a long test bar through the wristpin hole and giving the necessary twist with the long wrench shown. The alignment is then tested by swinging the rod so that the test bar rests on suitable parallels, while the alignment in the other direction is tested by measuring the distance between the large and small bars.

The main object in finishing the connecting-rods all

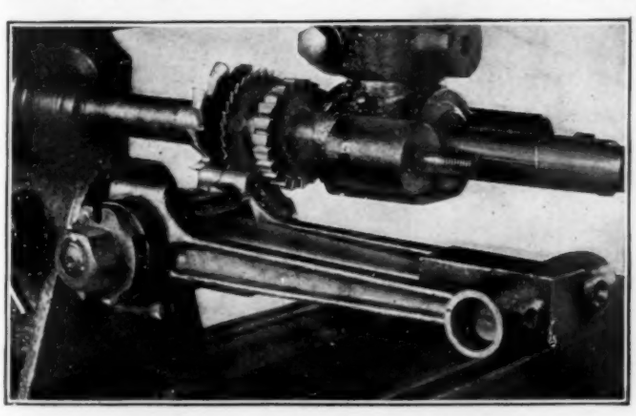

FIG. 9. SLOTTING THE END OF THE ROD

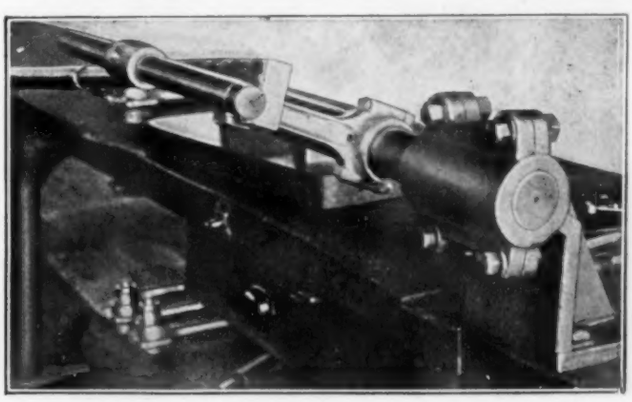

FIG. 10. STRAIGHTENING THE CONNECTING-ROD

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over is to assist in securing a perfectly balanced engine. In order to have this entirely satisfactory, the assembled piston, piston pin, and connecting-rod are held to a half-ounce tolerance. In order to secure this, a small amount of metal is left around the center of the wristpin end; weight being removed by filing.

Testing Plain and Forked Rods

BY FRANK C. HUDSON

The generally accepted design of the V-type motor includes the use of the forked or so-called spade rods which necessitates careful designing, extreme care in manufacture, and careful testing as to accuracy. The

FIG. 1. COMBINATION GAGE FOR PLAIN AND FORK ROD

accompanying illustrations show some of the methods used by the Ford Motor Co. on Liberty motor work.

Fig. 1 shows a combination gage used for testing the thickness of the crankshaft bearing end of the plain rod, while the upper member of the gage *A* forms a test block for the space between the two forks of the other rod. In Fig. 2 is a "go" and "no-go" gage for the outside diameter of the bearing of the forked rod. This is a very convenient form of bench gage as it allows the work to be handled very rapidly.

In Fig. 3 the rods are shown in the process of assembly, the main bearing being put in the spade or forked rod as shown. For convenience in handling, the rod is placed on the incline block at *A*, suitable studs being provided to hold it in position. This allows the part to be bolted together, using an ordinary socket wrench with a cranked handle like a bit brace. The incline of the block brings the work to a convenient angle.

An interesting and somewhat unusual testing fix-

FIG. 2. LIMIT GAGES FOR PLAIN ROD BORING

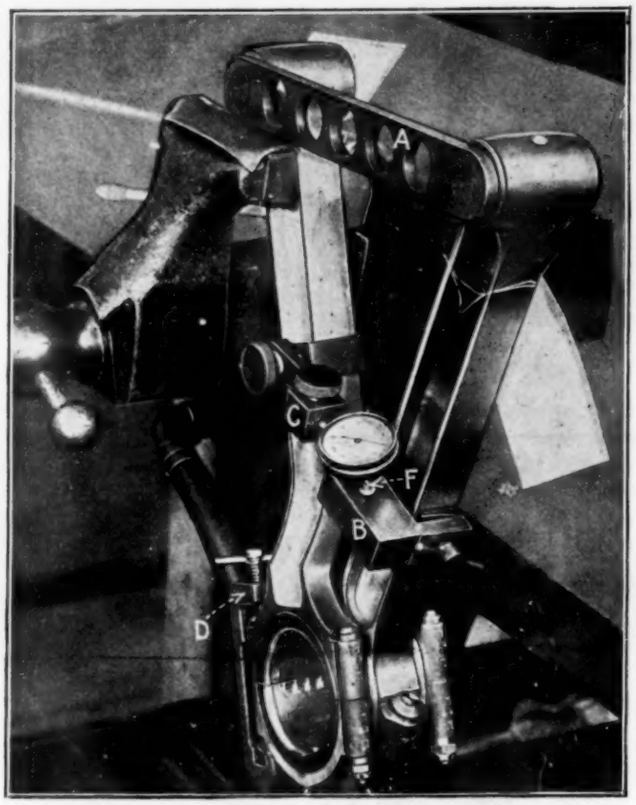


FIG. 4. TESTING CLEARANCE IN PLAIN ROD

ture is shown in Fig. 4. After the pair of rods are assembled together the forked rod is clamped in the vise which has suitably protected jaws for this purpose. The distance piece *A* is put in the two wristpin bearings, the block *B* fastened to the plain rod, and the dial-measuring device *C* clamped in a similar way to the other rod. A special clamp, the end of which is shown at *D*, is fastened over both bolts of the spade rod as shown. This block carries a small screw with a cross-handle as shown at *E*, which bears against the center of the large end of the plain rod. This screw allows any play to be taken up, the amount being shown by the dial indicator *C* which has its button located at *F*.

FIG. 3. ASSEMBLING THE FORK ROD

Industrial Relationship

By BASS SMITH

TO BRING out the vital importance of industrial relationship we do not need to view it from the standpoint of the parlor socialist or would-be reformer. Rather should we analyze and deal with it from the viewpoint of scientific inquiry and try to discover its significance in the economic welfare of the industrial and social organism. When it is thus analyzed, the human factor will be found to be a very delicately balanced piece of mechanism in our industrial machinery and which needs to be handled with sound judgment born of experience.

What are the qualifications needed by the industrial manager who wishes to outline a constructive policy of industrial relationship?

First—He should understand and like men; he should possess the human touch, as it were. He must be perfectly honest, have a keen sense of justice and square dealing.

Second—He should be a student and know something of economics and sociology. Many of the problems which will confront him require for their solution a comprehension of the laws and principles of both psychology and the social sciences.

Third—He should have that maturity of judgment which results only from the broad experience of years in close touch with the many phases of industrial activity.

Experience Necessary for Success

The proper person to handle questions of industrial relationship is one who has had actual shop experience as a part of his training. Many of the problems that arise are so closely interwoven with production, selling, administrative or financial details of a plant as to make a thorough familiarity with these factors essential. One with limited experience is apt to take a vague and impractical view. Because of their knowledge and administrative experience, the high officials in industrial organizations at times do successful work in matters of industrial relationship.

"A little knowledge is a dangerous thing." Now it is not dangerous if one realizes that it is a little knowledge, but one who possesses a little knowledge and acts as though it were a great deal becomes dangerous. Guided by such persons many ventures of welfare work end disastrously to the utter dismay of their projectors.

Most executives are sincere in their endeavor to have equitable working conditions and any skepticism they may have is apt to be due to contact with personal workers lacking a broadened experience and who are therefore unable to give constructive counsel to the management as to the various industrial problems to be met with. Of what use is it to advocate better conditions for the workman unless results can be achieved which are satisfactory to both sides? Anyone can propose higher wages and shorter hours, but it takes sound judgment born of experience to put across such steps without seriously hampering an enterprise.

True leadership is the secret of organization efficiency and is likewise the secret of industrial relationship. This demands a standard of personal efficiency to be practiced by the officials, department heads and foremen. The idea of simply handling the worker with the sole purpose of making him satisfactory and efficient for the management without aiming to make the management satisfactory and efficient for the worker is bound to result in discontent and unrest. There is a call for men to lead our industrial armies—men who realize what personal efficiency means and who aim to conform to its standards. They must be schooled to do their part in their conduct toward others; they must be imbued with a spirit of fair play and human brotherhood, and possess a real desire to see those around them live lives of worth and contentment. They must be able to discriminate between near discipline and real discipline in the management of men. They must be masters of their end of the business; each should be an active leader in his own niche, and capable of avoiding unwarranted adverse criticism from those below him.

The superintendents and foremen form the keystone of the arch in industrial relationship and it is necessary that they should be properly trained and fitted for the duties and responsibilities of their positions. They are the ones who, to the men, represent the policies and ideals of the company; and their actions for good or evil are quite naturally construed to be the policy of the firm toward its employees. The management is responsible for what takes place in an industrial organization and therefore has to bear the brunt of criticism for incompetency on the part of foremen or subordinates. It is consequently essential that the management use care and judgment in selecting and training these leaders.

The question of industrial relationship must be dealt with on both ethical and economic grounds; there must be honesty and justice on both sides; terms and agreements must be free from arbitrary demands not in accord with sound business judgment. Arbitrary demands gained by either side will ultimately defeat the ends sought, for no amount of subterfuge or attempted bolstering-up will stave off the certain outcome of arbitrary dealing. On the other hand, we must guard against sentiment and impractical idealism which are equally barren of good results. Let us keep to the straight line of practical common sense which recognizes true justice and the common good of all. Whatever work is done should be done along purely constructive lines as a policy of wisdom and justice.

Arbitrary Methods to Be Avoided

The following four points are based on my observation and experience along lines that will have to be constructively dealt with before any general advance is possible in the matter of industrial relationship.

First—There must be an equitable standard of remuneration for capital investment, especially for absentee capitalism. Large dividends of absentee stockholders are a subtle cause of unrest among workmen, and become a formidable weapon in the hands of the uninformed agitator or would-be reformer. A clear distinction should also be drawn, however, between the ownership and management of capital, in order to arrive at a proper remuneration for the use of capital solely. Among workmen in general, capital and man-

agement are regarded as essentially the same, as it appears to them anyone who does not receive a weekly wage is a capitalist. To the lay mind, capital and manual labor are the only two factors in production, no allowance being made for management, determinative and administrative skill or expert and professional knowledge which have required years of twice the proverbial eight hours per day for their acquisition. In short, we must distinguish clearly between the ownership and the management of capital investment in order to fix upon standard recompense for the use of capital as a tool of production.

Second—Labor will have to be given a voice in industrial government, for much of the friction which produces inharmonious relationships could be avoided if the opportunity was provided for discussion of the vagaries that are constantly in the minds of the workers.

The best method of procedure in this matter is a much debated question and one hesitates to advocate a general remedy; certainly the conditions of an individual firm must be well considered before hazarding an opinion. One significient fact must not be lost sight of—the vital difference between a "voice in the management of affairs" and "the mechanism provided for discussion of opinions and the settlement of grievances." The latter provision is quite sufficient under liberal, fair-minded management for all save perhaps a few radicals, and even these, under wise management, would be compelled to sit down and be quiet in a short time.

A voice in management is a different proposition. Incompetent, ultra-radical or hot-headed workers on the board of management might easily bring about a very undesirable state of affairs. If these men made demands that were impossible or unwise to concede, bad feeling might spread among the workers because their representatives could not obtain their demands. The point, briefly, is to discriminate between (1) providing the mechanism whereby the workers can express their desires and criticisms, and (2) the sharing of power without knowing whether it will be used wisely or abused.

Third—The necessity of fixing a minimum standard of living which will insure decency and comfort to every worker. Every human being has a right to this much as a social necessity and as a national bulwark against political disintegration. Society owes this much to the worker in return for the services which he renders to society.

Fourth—We must counteract the pernicious, popular fallacy that the dollar sign is the hallmark of success. The misconception as to what constitutes true success does more than anything else toward spreading ultra-radical doctrines throughout the social structure. If money spells success to the popular mind, it is natural that most people should make that their sole object of attainment. Constructive educational propaganda is necessary to counteract this fallacy.

It is no longer wise or safe for each individual to be a law unto himself. One must conform to that standard which is fast being laid down by the awakening social consciousness. The extreme individualist is being replaced by the man with vision to perceive that the good for one must be for the good for all.

Only in this way can we continue in peace and prosperity on the highway of national progress.

Gaging*

By E. C. PECK
Lieutenant-Colonel, P. S. & T., Division Standardization Section

It is a well-known fact that gages of some description have been used since man first began to contrive conveniences for himself. The standards of weight, measure and volume mentioned in the Bible are gages. The instruments and appliances used in building the pyramids were gages. In fact, it has been apparent from the beginning of time that standards for determining dimensions, capacity, quantity, force, etc., are not only necessary but aid materially in conducting all kinds of commerce and business.

In bargaining for a quantity of material, it is necessary to have a standard unit acceptable to both buyer and seller to determine whether the quantity bargained for is understood by both, and the bargain carried out.

Tribes, states and countries used gages originating with themselves, and probably the tribe or state doing the most trading with the neighboring countries succeeded in establishing their standards in other countries, and hence the most used gages were handed down to us. It certainly would have been much better for the present generation if there had been a little more coöperation among the ancients in regard to standardization; then we would not have the heterogeneous collection of gages or units that we are all familiar with.

It must be evident to everyone that all business and commerce would be conducted with less expense for the service rendered if standard specifications were in use, and had the same meaning all over the world. It would seem like a logical statement to say that some one system of standards ought to be enough better to win over the entire world by its greater utility, but this has not proved to be true. The two systems which most concern this country are the English and metric. Both are used extensively, both are legal and each has its advocates. It seems obvious that the outstanding advantages of the metric system have not been sufficient to supplant the English in this country. To me the outstanding advantage of the metric system is that all subdivisions are multiples of 10, and hence in calculations it is only necessary to move the decimal point in the reduction from unit to unit. Great advantage is also claimed in that the units of weight and volume are derived from the unit of measure, but to me this is of little account. For accurate work, one does not want to originate his own standards, but prefers to obtain them from the Bureau of Standards, which can compare a standard without regard to its origin.

One advantage claimed for the English system is that most sub-divisions are made by successively halving each unit. If these arguments are adhered to by the advocates of each side, they both fail, because their methods result in units the size of which are impracticable, based on experience.

In the English system, beginning with the inch and halving for each subdivision, we finally reach the units— 1/64, 1/128, 1/256, 1/512 and 1/1024—all of which are awkward to handle and not readable on the well-known micrometer without estimating. To obviate this difficulty, the inch is divided into tenths, hundredths, thousandths and ten-thousandths, and all of these decimal units are practicable and usable units.

In the metric system, the first subdivision of the meter

*From a paper presented at the Detroit meeting of the A. S. M. E., June 16 to 19, 1919.

is the decimeter, a unit 3.973 in., of no utility and rarely used. The next unit is the centimeter, a unit too large for good work and too small for use in distance measurements. The next is the millimeter, 0.03937 in., the most widely used unit because of the adaptability of its size value. Many industrial enterprises require no greater accuracy than a millimeter, and therefore, as this unit is about as fine as can be used on a steel scale, it is sufficient for their needs.

For tools and fine accurate mechanisms, the millimeter is too large, and so is the next subdivision, 1/10 millimeter, which is 0.0039. The great bulk of good work in our machine-tool, automobile and the tool-making industries require units between 1/10 and the 1/100 millimeter, as one is too coarse, and the other too fine.

The result of this is the halving and quartering of the millimeter and the 1/10 millimeter to get the usable units approximating 1/100, 1/1000 and 2/1000 of an inch. Thus it will be seen that the advocates of both systems use what the other claims as an inherent fundamental of his system.

If when the meter was adopted all romance and sentiment had been left out of the question, and the meter made 10 English inches, the metric system would have been in universal use long ago. The theoretical value of the meter is on a ten-millionth part of the distance from the Equator to the pole, and after this figure was established an error was found in the calculation, so that now we haven't even this sentimental advantage.

If the meter had been 10 in., metric threads could have been expressed in whole numbers per decimeter, and this would agree with present practice, and would fit in with the United States system.

The First Interchangeable Manufacture

The first interchangeable manufacture attempted was in France in the year 1717, and it failed. Another trial was made in 1785, which also failed. In 1798, Eli Whitney, of cotton-gin fame, took and completed a contract to make ten thousand muskets for the United States Government, and the parts of these guns were interchangeable.

English and French ordnance officers ridiculed and criticized Whitney's ideas to such an extent that Congress became alarmed at the money being used for the purpose. Whitney went to Washington with ten guns and distributed the parts on the floor, assembling repeatedly ten guns from these parts, that operated properly. This remarkable achievement astonished everyone, and it is believed to be the first successful interchangeable manufacture of accurate work. As nearly as can be found out from the records available, this occurred in 1800. In 1808, Simeon North accomplished a like feat on pistols for the Government.

It is also known that John George Bodner began to manufacture guns at St. Blaise in the Black Forest about 1806 by a new method, which is believed to have been partly interchangeable; that is, some of the parts like the lock and stock were made and carried in stock. Interchangeable manufacture is conceded to be an American development, and is described by writers on the continent as an American method. In 1853, a British commission visited the United States to investigate the methods in use, and as a result, ordered 20,000 Enfield rifles for the British Government, and later 157 machines for the government arsenals, and hired James H. Burton to install the machinery and methods.

From this small beginning the practice grew steadily in the armories and arsenals, and later as the advantages became known, it spread to bicycles, typewriters, and various other things, until now it is quite common to speak of interchangeable manufacture. There is no doubt but there is some difference between the exact meaning of the term then and now, just as there is a great difference between manufacture then and now.

There are several degrees of interchangeability, or at least several meanings to the exact interpretation of the term. Strict interchangeability consists in making the different parts of a mechanism so uniform in size and contour that each part will fit and properly function in any one of the whole number of mechanisms, no matter when or where it is made.

In the early days before modern machinery came into use, it was necessary to finish work by hand, and to make it uniform, template filing and finishing were resorted to. For example, gun and pistol parts would have the holes drilled and reamed in a jig or fixture, and then the contour finishing was done by putting these pieces into a template jig provided with pins to fit the holes. The outside of the jigs would be a duplicate of the shape and size of the model piece and hardened. The workman would then file down to the hardened template, which controlled the shape and size of the piece. Many ingenious devices and schemes were used to facilitate the duplication of parts, and great skill was developed in the workmen.

The great improvement in machine tools, especially as to accuracy of output, was a very great factor in promoting interchangeability, and here again, America has led the world. The refinements, accuracy and efficiency of modern machine tools are strictly American.

American labor costs so much more than foreign that to compete in the world markets, we had to obtain as much product for each dollar of labor as our competitiors, therefore, we had to develop machinery to get more product for less labor. This in turn has developed skill in our mechanics, and raised the standard of living so that today American skilled workmen are the best paid in the world.

It is a fundamental law that interchangeable manufacture is facilitated by the largest allowable freedom in the fit of mating parts without interferring with the proper functioning.

Allowances and Tolerances

This leads up to the subject of allowances and tolerances, one of the simplest, but least understood in the whole system of interchangeability. As these two words will be used repeatedly, it is well to point out the difference between them.

Allowance is a prescribed difference between the dimensions of two mating parts to produce a desired kind of fit. Example: A standard hole exactly 1 in. in diameter, with a free running shaft, the journal diameter of which is 0.998 in. The difference between this hole and the journal prescribed for the oil is 0.002 in. and this is the allowance.

Tolerance is the prescribed difference in the dimensions to tolerate the unavoidable errors or variations in manufacturing a large number of pieces.

In the above example, if a thousand running fits were to be made, the holes might be dimensioned 1.000 in. $^{+\ 0.005}_{-\ 0.0000}$ This half thousandth permissible error is the tolerance.

The shaft journal might be dimensioned 0.997 to 0.998 in. and this permissible error of 0.001 in. is the tolerance. Then the minimum allowance is 0.002 in. and the maximum looseness or the sum of both tolerance and the minimum allowance is 0.0035 inch.

Thus the kind of fit is finally determined by the combination of the allowance and tolerance, and most engineers prefer to use allowance as a minimum value, which is never intentionally encroached upon, the tolerance providing for larger freedom of fits. The reason for this is that the data for minimum allowance is more reliable and has been more clearly demonstrated than the maximum allowance, and as it is vital, it must be unaffected by tolerances. This is plainly evident in the case of free moving parts, as it is well understood that a space must be provided for an oil film, and this space must not be so small as to endanger failure by the parts seizing.

There are many conditions in which maximum looseness determines the strength of the parts or the limits of engagement, and any more freedom of fit would make the parts unsatisfactory. When this is the case, maximum looseness must be the starting point in the calculations, and this must then be unaffected by tolerance. Then if minimum allowance can be determined, the difference between these two, maximum and minimum looseness, will be the sum of the tolerances.

The tolerances are then divided between the mating parts according to the manufacturing ability to produce the parts to uniform size. That is, if the manufacturing ability is

such that it is much easier to produce uniform size to one member than the other, the tolerance on the members is divided in direct proportion to this condition.

Very often the allowance has zero value; that is, there is no clearance whatever allowed for the fit, and in a single pair of mating parts, they fit metal to metal. Now if a large number of such parts are to be made, it must be determined whether this zero allowance is for the tightest or the loosest fit permissible.

The term "negative allowance" is often used to indicate that we allow a certain prescribed amount to make a tight or force fit, and is very confusing because it implies being substracted, and this is not the case. According to present usage, zero allowance indicates that there is no clearance or space allowed between the two mating parts. Positive allowance indicates that there is prescribed a space between the mating parts. Negative allowance indicates that there is less than a space provided for between the mating parts, or an imaginary space displaced by the flow of the metal to make a tight fit.

The minimum allowance or greatest tightness and maximum looseness must be known when the tolerances have been set, and usually they are known at the time tolerances are set. There are, however, cases in which it is known that certain tolerances are the smallest that can be successfully used in manufacture, and then maximum looseness and maximum tightness must be adjusted to obtain the best functioning condition in conjunction with these tolerances.

After determining the maximum and minimum looseness of mating parts and setting the tolerances, it becomes necessary to control the dimensions of the parts so that none of the dimensions will be outside of the limits established, and this is best done at this time, for strictly interchangeable manufacture by the use of proper "go" and "no-go" gages. First-class gages are expensive, and soon wear, so that strict interchangeability is sacrificed to keep down gage cost.

Old Method of Using "Go" Gages

In times past it was common practice to use "go" gages only, and limit the looseness of fit by the shake of the piece in the gage, or where a little more refinement was practiced, a piece of newspaper was used on one side of the "go" gage, and if the piece which passed without the paper, was tight with the paper, it was accepted. A piece of newspaper used with each of a pair of mating "go" gages usually produced a freedom of fit from 0.004 to 0.006 in., and with skilled help, it produced satisfactory results.

For strictly interchangeable quantity-production work of good character, a good gaging system will prove economical. Such a system comprises the minimum number of properly designed gages to control all the factors of the various parts of a mechanism, so that they will assemble and function properly. This assumes that proper allowances and tolerances have been established.

The designer should always keep before him the fundamental that tolerances should be as large as proper functioning will permit, and he should be well informed what tolerances successful manufacturers actually work to. He should take pains to learn how tight and how loose working parts can actually be, and give satisfactory results.

Once these tolerances are set as large as the designer will risk, they should be rigidly adhered to, and considered a boundary line. The product should always be kept within these boundary lines, and this is best accomplished by making the component drawing dimensions the master-gage dimensions. Then with all the working and inspection gages checked against the master gage, and never allowed to wear beyond master-gage dimensions, the work is bound to be within component dimensions.

As exact duplicate master gages cannot be made except at a prohibitive cost, a master-gage manufacturing tolerance is allowed. This tolerance is usually in good practice from 4 to 6 per cent. of the component tolerance, and is applied in the direction to keep the work within the boundary line defined by component dimensions. This gage tolerance is treated as a wear limit, and robs the working tolerance by this 4 or 5 per cent.

Inspection gages are usually of the same design as the working gages, and often the same as the master gages, but should have an additional allowance for wear. Inasmuch as the gages will wear, and as they are expensive, the exact amount to allow for wear is an economic point for each manufacturer to decide, keeping in mind that a small wear limit increases the gage cost, and a large wear limit requires closer attention and work at the machines.

Where experience is lacking, it is good practice to allow 10 per cent. of the component tolerance for wear on the "go" gages; as the "no-go" gages wear but little, 5 per cent. will be sufficient. The inspection gage can only represent extreme tolerance limits when worn to master gage size. The working gages are those used to check the work as it is machined, and should have liberal wear limits to insure the work being passed by the inspection gages.

Thus it will be seen that this system, if followed, will admit of the acceptance of work that will be interchangeable. It also emphasizes the fundamental that tolerance should be as large as will properly function.

If the tolerances are too small the work will be more costly, because better workmen will be required, and this always means higher wages. Better tools and machines to produce the close work, and more frequent adjustment and attention is also necessary as well as additional gage cost. Close tolerances cause large rejections of the work, and more or less friction between the inspector and those responsible for the work.

Screw-Thread Work

The examples and descriptions so far have applied to all kinds of interchangeable work with no particular reference to screw-thread work, and while the principles and practice are the same, a great deal more care is required to produce strictly interchangeable screw-thread work than plain work. The problem becomes more difficult because a larger number of factors make up a proper screw-thread fit, and a big error in any one of the factors, will prevent a proper fit. A comparison of these factors may help to make the solution more comprehensible. A cylindrical fit depends upon the size, rotundity, and parallelism of the mating parts. Rectangular sliding fits depend upon size, contour, and parallelism of the mating parts. Of course, they all depend upon size, but in a screw-thread fit, size is affected by the errors of the lead in the mating parts, and the errors in the angle of the thread. Thus the factor contour in a screw thread is made up of the factors of lead and form of thread.

Two mating parts with correct lead require no compensation in size for the lead factor. Two mating parts with an equal lead error in the same direction, either long or short, require no compensation in size for the lead error. Two mating parts with differing lead errors or the equivalent, require a compensation in size for this lead difference to enable the mating parts to go together.

Two mating parts in which the contour of the thread is affected by an error in the angle of the flanks of the thread, must also have a compensation in the diameter to offset the angle error, or the metal must flow to make the fit. Thus it will be seen that strictly interchangeable screw-thread product is more difficult to produce, and if good fits are required, close tolerances and good thread-producing tools are necessary. There must be a rigid inspection and means of controlling all factors which make a fit.

Where gages are used, as at the present time, they must be periodically checked against the master gages in order that boundary lines are not encroached upon. It is fundamental that the "go" gages should check all the factors simultaneously, and the "no-go" gages should check the factors separately. This must be obvious when it is remembered that lead and form are compensated for by increasing the diameter, and hence to be sure of the correct relation of all the factors to each other, they must be gaged at once, and with a gage as long as the engagement of the mating parts. The exception to this is the minor diameter of the nut, and the major diameter of the screw. To include these two dimension factors in the "go" gages, would make the cost of the gages prohibitive, and as these surfaces in the mating parts are intended to be cleared when assembled, it is practicable to gage them separately.

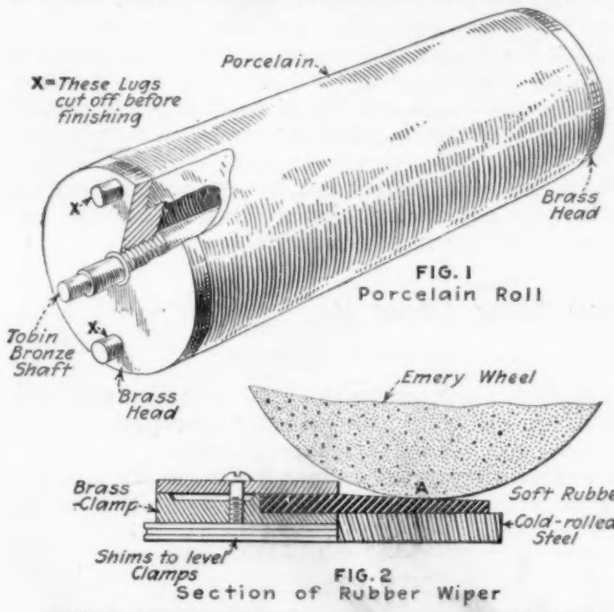
Unusual Jobs With Unusual Materials

By R. P. Deane

Mechanics employed in the maintenance and development departments of manufacturing plants often have queer jobs to do and occasionally queer materials to handle. Some of my jobs may therefore be of interest to readers of the *American Machinist.*

We recently had to replace a brass roll about 5 in. in diameter and 24 in. long in a glue machine. We had several similar machines of a later model having porcelain rolls instead of brass and which gave much better satisfaction, so we decided to make a porcelain roll.

We procured a porcelain cylinder of the proper diameter and length with a thickness of wall of about 1 in.



FIGS. 1 AND 2. THE PORCELAIN CYLINDER, AND GRINDING A RUBBER "WIPER"

It had a beautiful finish on the outside but the ends were not square with its axis nor was the inside either round or concentric.

We put the cylinder in the lathe chuck and center rest and tried to grind it but the result was an absolute failure, the wheel glazing and leaving only a black streak like a lead pencil mark on the porcelain.

The only diamond tool that we had was an emery-wheel dresser which we mounted in the toolpost and with it were able to face the ends of the cylinder and bore the inside for a distance of about ¼ in. at each end. The porcelain, however, was almost as hard as the diamond and the latter was worn so small that we had to buy a new one for our emery wheels.

We then made two brass heads, leaving a shoulder to fit into the roll, and threaded them to fit a Tobin bronze shaft, one thread being right hand and the other left so that they would not work loose when the machine was in service. Lugs had been cast on the heads to afford a means of tightening, and when the whole was assembled, the lugs cut off and the heads and journals finished, it made a first-class job, as may be seen in Fig. 1.

We often have to grind soft-rubber rolls, which operation is common enough, but recently we had to make some soft-rubber wipers like Fig. 2, these being from 20 to 38 in. long. The rubber must be stretched as it is tightened in the brass clamp to give it a tension and then the surface *A* must be ground so that will lay perfectly flat on the roll.

We strapped the work onto the planing-machine table with a piece of cold-rolled steel under the rubber for a support and set up the toolpost grinding machine so that the wheel revolved across the table instead of parallel to it; also so that the revolution of the wheel would tend to draw the rubber away from the clamp. The concavity produced by the wheel was not a disadvantage.

We sometimes get felt polishing wheels without holes for the arbor and we bore them in the lathe by using a carpenter's expansion bit set to the proper size and held in the tailstock chuck. We pull the belt by hand so that the worm on the bit will not go through too fast. This works to perfection.

We had some stitched-canvas polishing wheels about 14-in. diameter, by 4-in. face. These were too heavy to run at the speed that our jacks run so we cut them down to about 10-in. diameter, sawing as close as possible to a line on a band saw and afterward turning them with a wood-turning tool.

Putting an Old Idea to a New Use

By I. E. Pearce

Not long ago we received a rush order for a large quantity of special pipe fittings as shown in Fig. 1. We had the option of making the fittings from malleable-iron castings or lap-welded pipe with welded flanges of hot-rolled plate. The latter was chosen because all work could be done in our own plant, which would eliminate the possibilities of poor deliveries from an outside foundry. It was decided to turn the entire job of making the fittings, ready for the machine shop, over to the welding department, which

immediately looked about for means to facilitate the cutting of the pipe and flanges, and the assembly welding. The writer had had considerable experience with the Lockman multiple-spindle carving machine, which is used for duplicate carving in furniture making, and it occurred to him that the pantograph idea could be applied to the cutting out of the flanges.

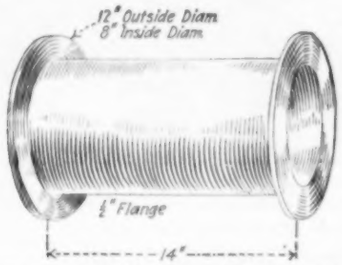


FIG. 1. A WELDED PIPE FITTING

The tool designers were consulted, and after experimenting with a common wooden pantograph and studying the various designs of this device in drawing-instrument catalogs, we submitted pencil sketches to the toolroom which completed the fixture in a few hours.

It might be well to add here that while this idea was apparently original with us, we have since learned that similar apparatus was in use in the shipyards for fabricating ship plates.

The fixture was scaled to enlarge 1:2 and consisted of a base *A*, as shown in Fig. 2, fixed to the welding bench. The parallelogram rods, which were made of ¾ x 2-in. cold-rolled rod, revolved about the shoulder screws *B* as bearing points. *A* device *C* for holding the cutting torch *D* was mounted on the rod *E*, and arranged to move along the rod so as to obtain the correct dimensions for the flange. A cast-iron block *F* with two circular grooves *G* turned in the face served as the templet for the flanges. The sheet of boiler plate *H* was placed on the bench and the hole for the pipe was first cut out by the torch which was guided by the roller stylus *I* following the inner grooves in the templet. After the hole was cut out the stylus was changed to the outer groove and the flange cut from the plate. The weight of the torch and pantograph was compensated by the weighted wire cable *J* which passed over pulleys located in the ceiling.

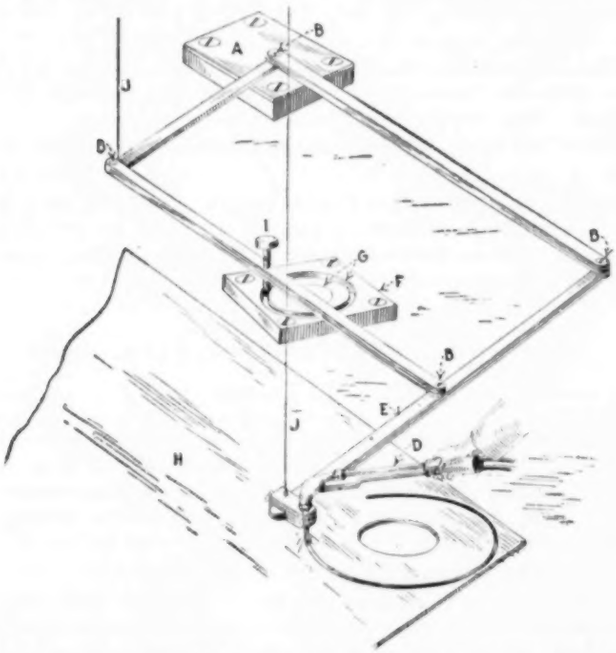


FIG. 2. THE PANTOGRAPH AS APPLIED TO ACETYLENE TORCH CUTTING

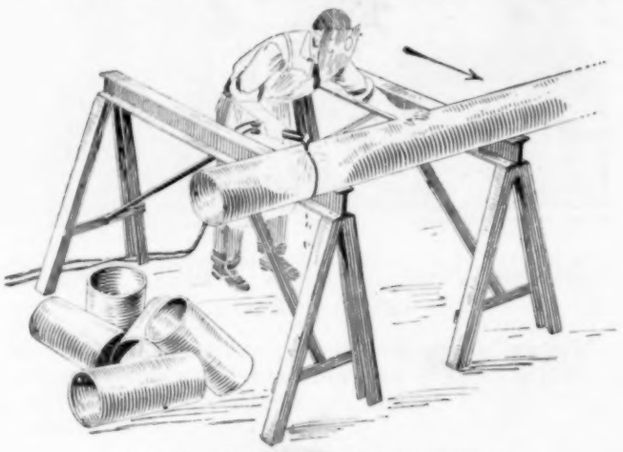


FIG. 3. CUTTING OFF THE PIPE

The cutting off of the pipe was done as shown in Fig. 3. The pipe was placed on a pair of horses and a chalk witness line drawn around the pipe at the proper point. The operator rolled the pipe along the horses in the direction shown by the arrow with one hand, while he applied the torch with the other. In welding the flanges to the pipe, considerable time was saved by placing a ⅜-in. iron rod hoop in the corner made by the flange and the pipe, which, when fused by the welding torch, aided materially in forming the fillet at this point.

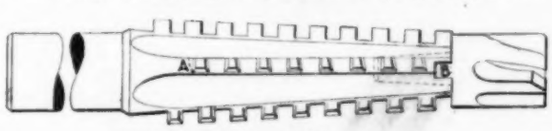
With one man cutting out the flanges and cutting off the pipe and another man welding, an average output of 15 fittings per day was maintained.

Roughing Taper Reamer for Cast Iron

By W. H. Addis

The cast-iron hubs for the army escort wagons presented one very difficult machining operation; namely, the machining of the long tapered bore.

Roughly speaking, the taper is ¾ in. to the foot and 10½ in. long, the finished diameter of the bore at the small end being $1\frac{13}{16}$ in. and at the large end, $2\frac{1}{32}$ in. As large quantities were to be made, it was very desirable from a manufacturing standpoint to use a taper core which would leave about ⅛ in. of metal to be removed in finishing. Many styles and types of tools and expedients were tried without success but with the adoption of a straight core and the combination rose bit and roughing reamer described as follows, all difficulties were overcome:



A ROUGHING TAPER REAMER

A bar was roughed out to size and cut with a single ½-in. square thread. The small end was then bored to

receive a No. 2 Morse taper plug. A centered plug was inserted in this hole and the bar was fluted in the milling machine as shown. After fluting it was set up in a lathe and the cutting teeth were given clearance on the rear land by cutting away a small section of the tooth, represented by the dotted line at *A*. The thread being right hand, the cutting away of this portion of the thread helix served the double purpose of clearance for the tooth, and prevented the reamer from leading into the work. The bar was next splined *B* to receive the key of the rose bit.

An Electric Indicating Gage

By D. C. Cook

The possibility of designing gages for quantity inspection, so that a flash of an electric pilot light or a click in a telephone receiver indicates whether the piece being inspected is within the specified tolerances, is without limit. It has been successfully demonstrated that, by the use of electrically indicating gages, the possibility of error is greatly reduced and the output increased, as compared side by side with the usual style of direct-reading multiplying-dial gages.

The accompanying illustration shows a surface gage modified along the general lines of electrical indicating gages. This gage has proved to be a timesaver in checking up alignment and associated parts in machine assemblies, where it is often a difficult matter to get the "touch" when the scriber comes in contact with the gaging points, but there is no room for doubt when this device is used. The stem hole in the scriber clamp *A* is enlarged about 0.012 in. to take a split insulating bushing *B*. This bushing can be easily made by rolling up a cylinder of book paper using shellac as a binder. A wire *C* of any convenient length is connected to one terminal of a common dry battery and soldered to a spring clip which is attached to the scriber clamp as shown. A telephone receiver *D*, preferably one with a head band, is placed in series with the battery and the ground *E* which is placed at any point on the metal frame of the machine, completes the circuit.

AN ELECTRIC INDICATING GAGE

Drafting-Room Kink

By Henry H. Moore

The following idea I have found to be of advantage when sketching large heavy fixtures. I place the work on a revolving stool and set it next to the board where

A SKETCHING KINK

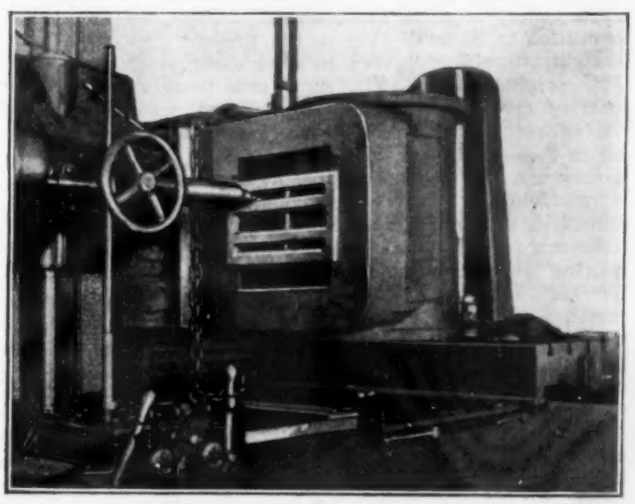
it can easily be reached. All I have to do is to revolve the top of the stool and I have easy access to any surface. The sketch may aid in understanding the scheme.

Milling Cylinder Ports

By I. B. Rich

One of the uses to which the horizontal boring machine is put in railroad shops is shown in the accompanying illustration. Here a locomotive cylinder and half saddle is mounted on the table of a No. 32 Lucas horizontal boring machine, while the valve seat is being machined.

The valve seat itself is surfaced with a large inserted-tooth milling cutter, while the small cutter shown is used to mill the outside of the raised portion forming the seat and also to clean out the valve ports as shown.



MILLING PORTS IN LOCOMOTIVE CYLINDER

British Tool and Metal Industries

Extracts from the report of the Special Commissioner of the United States Department of Commerce Alexander Luchars, who has been studying trade conditions abroad and writes from London.

WITH the exception of plants formerly engaged in munition manufacture, activity is the rule among machine-tool and metal manufacturing industries here, caused principally by the changes from war to peace production; and as considerable time will be required to complete such changes, this activity will probably continue unless the labor troubles result in a complete stoppage of manufacture.

The turnover from war to peace production is well illustrated in the case of Sir W. G. Armstrong, Whitworth & Co., Ltd., one of the largest armament makers in the country. Although every provision has been made for the quick resumption of war work if future events demand it, the main works at Elswick, Scotswood and Openshaw are being rearranged for the manufacture on a large scale of machine tools, locomotives, marine engines and turbines, brass and other non-ferrous alloys (including brass and bronze powders), castings, stampings, and pneumatic tools, as well as all classes of commercial shipbuilding. Motor-car construction and the equipment of electric power plants are also to be resumed. New shops and a large increase of plant are being provided for the machine-tool and small-tools department. The manufacture of tools will follow the best modern methods, and it is stated that "all standard types will be produced."

Extensions to Machine-Tool Plants

Other well-known machine-tool firms making extensions are:

J. Butler & Co., Halifax, manufacturers of planing machines, shaping machines and slotting machines, who are erecting new works; William Asquith, Ltd., Halifax, manufacturers of boring and drilling machines, who are generally remodeling their plant and reëquipping a large works formerly used for shell production; Dean, Smith & Grace, Ltd., Keighley, manufacturers of lathes, who will double the size of their existing works; Denham's Engineering Co., Ltd., Halifax, manufacturers of lathes and slotting machines, who are making enlargements and installing new plant; the Churchill Machine Tool Co., Broadheath, Manchester, manufacturers of grinding machinery, who are building works which will cover about 14 acres; Smith & Coventry, Ltd., Salford, Manchester, manufacturers of milling machines, who are also erecting new works, and H. B. Clay & Co., Birmingham, manufacturers of milling cutters and small tools, who are taking over a fair sized works.

All these firms and others not mentioned are full of orders; in some cases it is stated that they are sold up for 18 months. The fact that large numbers of second-hand tools are being placed on the market does not materially affect orders in some lines, although there are still large quantities to be sold. Up to the present such tools have brought surprising figures, in some cases much more than their original price. The same conditions apply to new tools of certain kinds that are in great demand, due to the efforts of other industries to resume operations for which they must have tools of some kind, if only for temporary use, and also because hardly any machine-tool maker is producing to capacity, principally on account of labor difficulties. Complaints of backward deliveries of new tools are frequent, one case being where a firm has been waiting over nine months for some presses not yet delivered. Until the extensive reorganization work mentioned is complete this condition will continue. Many of the machine-tool builders would be enjoying a run of prosperity equal to that of the war if they could produce to capacity. The volume of business is very large and the excess profits tax has been reduced from 80 per cent. to 40 per cent. minimum, increasing the net profit in some cases. Most of the tools turned out on home account are being used to supplement existing equipment, but the new motor car industry requires a large proportion.

There is a greater tendency toward specialization, because British machine-tool makers had plenty of object lessons of its value during the war, but many large machine-tool makers are notable exceptions. One well-known concern makes no less than 12 different types of machine. A lot of "two dozen" standard tools, such as lathes or drilling machines, is here regarded as a large "bath." There are hundreds of small employers operating shops with a handful of work people, men, women, boys and girls, who will continue to operate in the same way to which they have been accustomed for a generation or more. They have practically no overhead to think about and are making a good living at present prices. Little is being done in designing new tools, and not many new catalogs have been printed.

Some British Combinations

A tendency toward specialization and to a consolidation of their lines is noticed in some cases, the principal one being that of the Associated British Machine-Tool Makers, Ltd., consisting of 11 large concerns that have combined not only for marketing purposes, but for the purpose of improving designs and reducing manufacturing costs. Each works now concentrates on a limited number of types, so that large lots of similar machines are turned out on a repetition basis in the American way. Each firm retains its identity, ownership and control, neither capital nor other interests being pooled. The Associated British Machine-Tool Makers, Ltd., comprise:

James Archdale & Co., Ltd., Birmingham, medium-sized drilling machines; milling machines, horizontal and vertical.

William Asquith, Ltd., Halifax, large radial drills.

J. Butler & Co., Halifax, planing machines, shaping machines and slotting machines.

Churchill Machine Tool Co., Manchester, grinding machinery.

Kendall & Gent, Ltd., Manchester, planer-millers, vertical millers, horizontal boring and milling machines.

John Lang & Sons, Ltd., Johnstone, Glasgow, lathes.

Thomas Shanks & Co., Johnstone, Glasgow, heavy machine tools for railways, shipbuilding, marine-engine work, etc.

J. Parkinson & Son, Shipley, universal milling machines and gear planing machines.

Geo. Richards & Co., Broadheath, Manchester, turning and boring mills; drilling, boring and milling machines; side planing machines; keyway milling machines.

Smith & Coventry, Ltd., Salford, Manchester, sensitive drills, relieving lathes, horizontal milling machines, and bevel-gear planing machines.

H. W. Ward & Co., Ltd., Birmingham, capstan lathes, hand screw machines, and turret lathes.

A very wide range of tools is covered by the association, and to enable them to quote for complete equipment they have taken up sole agencies for other non-competing manufacturers. To ensure adequate representation abroad they have opened branch offices in Belgium, France, Holland, Italy, the Argentine and India, with a competent engineer as manager, assisted by a staff of expert machine-tool representatives in each office. [A full description of this association appeared in the *American Machinist*, May 17, 1917.—Editor.]

Besides the Associated British Machine-Tool Makers, Ltd., associations of manufacturers of the following products have been formed:

Milling Cutter Manufacturers' Association—Formed in 1918 "to deal with all matters interesting or affecting the makers of these tools"; membership believed to be large, but details not procurable. Secretary, P. M. Archer, Sir W. G. Armstrong, Whitworth & Co., Ltd., Openshaw, Manchester.

British Screwing Tackle* Manufacturers' Association—Formed in 1918 "to look after the interests of the screwing tackle industry." Honorary Secretary, Mrs. F. Turrell, the Coventry Ordnance Works, Ltd., Coventry.

British Gage Manufacturers' Association, Ltd.—Formed in 1918 "with the object of encouraging, promoting and protecting the British gage manufacturers' industry and generally to watch over and protect the interests of the gage manufacturers of Great Britain." Secretary, A. L. Pailthorpe, 44 Caxton House, London, S. W. 1.

Association of British Driving-Chain Manufacturers—Formed to develop the use and application of chain driving, the value of which its manufacturers feel is not yet appreciated by power users, and to keep down the cost of chain driving. The policy projected includes the standardization of chains, wheels, and chain wheel cutters to ensure interchangeability; elimination of unnecessary sizes of chains, which have been a source of confusion and difficulty to the user; increasing the output so as to secure a larger share of overseas business than at present. The members of the Association are the Alfred Appleby Chain Co.,

*Taps, dies, wrenches and chasers.

Ltd., Birmingham; Brampton Bros., Ltd., Birmingham; the Coventry Chain Co., Ltd., Coventry; and Hans Renold, Ltd., Didsbury, Manchester.

The last four associations mentioned are aparently not intended as selling organizations.

Some examples of permanent additions to lines since 1914 are furnished by:

Denham's Engineering Co., Ltd., Holmfield, Halifax; 13-in. toolroom lathes; 17-in. high-speed lathes.

Colchester Lathe Co., Colchester; all-geared head lathes.

Clifton & Baird, Ltd., Johnstone, Glasgow; high-speed friction sawing machines.

James Bennie & Sons, Govan, Glasgow; punching and shearing machines, built-up steel-plate type.

Stephen Stell & Co., Ltd., Keighley; 15-in. and 19-in. engine lathes.

C. Redman & Sons, Halifax; 43-in. swing surfacing and boring lathe.

The Power Plant Co., Ltd., West Drayton; Sykes gear generating machines.

Oldfield & Schofield, Ltd., Halifax; precision grinding and pillar shaping machines.

New Fortuna Machine Co., Ltd., Bristol; internal grinding spindles.

Morton & Weaver, Coventry; plain grinding machines.

Monometer Manufacturing Co., Ltd., Birmingham; die-casting machines.

D. Mitchell & Co., Ltd., Keighley; 48-in. radial drilling machines.

John Lang & Sons, Ltd., Johnstone, Glasgow; light pattern lathes.

Jones & Shipman, Ltd., Leicester; plain and universal grinding machines; radial race grinding machines; heavy-duty drilling machines, to drill 3 in. from solid.

Humpage, Thompson & Hardy, Bristol; gear hobbing machines.

G. & A. Harvey, Ltd., Govan, Glasgow; all-geared head lathes, 18-in. to 36-in. centers.

Automotive Industry

In this industry, which is protected by an import duty of 30 per cent., reorganization work is more in evidence than in any other. Motor-car manufacturers, during the war, built up enormous works which were engaged principally on munitions and war material. These factories are being reëquipped to carry out comprehensive post-war programs and require a large supplementary amount of equipment. In some cases entirely new machinery must be installed, the existing plant being practically useless for economical motor-car production. It is unlikely that new cars will be produced in anything like quantity this year and the high prices of automobiles will therefore continue. Some firms have been more fortunate in respect to changing over than others; for example, Sunbeam Motors, Rover Motors, Claytons and Crossley Motors were engaged on car production during the war, and can soon change to the new models.

An unusual development has taken place during the war in the manufacture of magnetos, spark plugs and other accessories such as were previously imported.

The increased war demand and the cessation of German supplies brought a number of manufacturers into the field who have since combined under the title of "British Ignition Apparatus Association," with the result that foreign competition is likely to be rendered difficult in the future. There is no Sherman Law in Great Britain. The names of the firms in the association are:

C. A. Vandervell & Co., Acton Vale, London; North & Sons, Ltd., Watford; the Thomson-Bennett Co., Coventry; P. N. L. Magneto Syndicate, Ltd., Coventry; Electrical Ignition Co., Ltd., Birmingham; British L. M. Ericsson Manufacturing Co., Ltd., Beeston, Notts; British Thomson-Houston Co., Ltd., Coventry and Willesden; British Westinghouse Electric and Manufacturing Co., Trafford Park, Manchester. Other concerns outside the association, including Vickers, Ltd., London, are also manufacturing magnetos.

Twist Drills, Chucks and Small Tools

The extraordinary demand for twist drills has directed some attention to the production of twist-drill machinery. Two concerns, Herbert Hunt & Sons, and Isaac Best, Ltd., both of Manchester, are specializing on a line of machines for twist-drill turning, pointing and cutting-off, grooving, clearance milling and groove grinding.

Strong competition has been started in the manufacture of American scroll chucks and in small tools such as center drills and counterbores, boring-bars, toolholders, drill sleeves and sockets, etc. The manufacture of lathe chucks has been taken up by F. Pratt & Co., Ltd., of Halifax, who have changed over from the manufacture of machine tools and will specialize on chucks. Jones & Shipman, Ltd., of Leicester, is devoting several departments to the manufacture of scroll-type self-centering chucks, Slocomb type center drills and countersinks. It is said that the selling price will be considerably less than that for which the American product can be sold for here; taking sleeves and sockets as an example, Jones & Shipman have reduced manufacturing costs to a figure that will allow them to undersell the cheapest German product offered here before the war.

The brisk demand for small tools has led to an increase of about 60 per cent. in the number of persons engaged in this trade since 1914. Permanent additions to the lines of concerns since 1914 may be itemized as follows: Self-opening die heads, screw gages, taps and dies, self-centering chucks, belt lacing tools, tool stands, twist drills, micrometers and snap gages, toolholders, center drills and countersinks.

Particular activity is shown in jig production, the demand for jigs and fixtures far exceeding the capacity of the toolrooms of the individual plants. A number of small concerns have entered the field to supply this demand, and some of the larger firms, such as W. Beardmore & Co., Glasgow, and W. H. Allen & Co., Bedford, have built extensions or departments for the exclusive manufacture of jigs, fixtures, gages and special tools from customers' own designs.

The impetus given to domestic agriculture during the war has resulted in a marked increase in the output of farm tractors, the manufacture of which has not only been taken up by the east country agricultural machinery makers, but by motor car and other concerns, notably the Austin Motor Co., Ltd., Birmingham; D. L. Motor Manufacturing Co., Ltd., Motherwell, and Melchoir, Armstrong & Dessau, Ltd., London. In the main, these tractors follow the American four-wheel type, with engines arranged to start on gasoline and run on a heavier oil fuel.

Other developments, in response to growing demand, are in connection with motor ploughs, steam tractors and small gasoline and oil engines, coupled to pumps or electric generators for working in isolated locations.

Statistics of the Machine-Tool Industry

It is difficult to arrive at anything more than an approximate estimate of the number of work people engaged in the British machine-tool industry. The approximate number of shops is about 200, and figures which I have obtained and have had verified by authorities show a total of about 26,000 workmen in 1914 as against 32,000 in 1919. The above figures do not include concerns making forge and blacksmith shop, patternmaking and foundry tools, heat-treatment furnaces and small tools and accessories. This group will number 100 concerns at least, and approximately 6000 workmen were employed in 1914, which number has been increased in 1919 to at least 7500.

Dealers report a steady and general demand for high-class tools, except automatics, which show a slight decrease owing to the disbanding of the government fuse factories which set free a large number of these machines. A good demand should continue for small (12- to 14-in.) and medium (17-in. and upward) high-class engine lathes, turret lathes, grinding machines, broaching machines, heavy-duty and multiple drilling machines, milling machines, gear cutting machines, automatic screw machines, die-casting machines, chucking machines, precision bench lathes, machinists' small tools, and particularly tools adapted to the economical production of such parts as automobile-engine cylinders, gears, back axles, connecting-rods, etc.

No Government Restrictions on Tool Imports

There is at present no restriction in, nor governmental control of, the imports of machine tools and kindred products, nor is any license required to import them. The only limitation is the amount of shipping space available from America. Some Americans take an erroneous view of our favorable trade balance and the enormous sums due us from Europe; but a moment's thought will show that these favorable balances, adverse to Europe, are a handicap rather than a stimulus to our export trade because the present demoralized exchange rate represents an increased cost to British importers of over 10 per cent. on American products.

British government sales of machine tools are being conducted so as to disturb the market as little as possible. Prices rule uniformly high in the case of standard tools, and the last sale produced about £150,000. A new method

was adopted—that of overhauling each second-hand machine before it was offered and putting it in such a condition as to render it immediately available for work. In this way the Government obtained the benefit of what is known as the "immediate delivery premium," which more than repaid the money expended in overhauling the machines. The government policy on the tariff question is unknown, but an announcement is expected in September. Public opinion on the question is divided.

British makers at present cannot begin to meet the demand for certain kinds of machines produced in the United States, such as automatics, broaching machines, multiple-spindle drilling machines, vertical surface grinders, and bench precision lathes, and they will continue to buy them there; while the demand for cylindrical and internal grinding machines and high-class engine lathes is considerable.

A national desire has developed in Great Britain to manufacture machine tools, as well as everything used or consumed in the country; and this feeling has been emphasized by the unfavorable exchange rate which prevails, the pound sterling selling almost as low as at any period of the war.

While there is the utmost good feeling on the part of the British toward America, the tendency is strong to place orders for all kinds of machinery at home, even at a somewhat higher price, if the machines are made here. Two large orders for railway equipment, one for India and the other for Canada, I am informed, have lately been placed in Great Britain at prices higher than American manufacturers offered, although all British locomotive works are behind in their deliveries, one being said to be 18 months behind. All the railroads here build their own locomotives, the independent manufacturers making principally for export.

Increase in Selling Prices

The accompanying table exhibits roughly the average increase in the 1919 selling price of certain classes of British tools. The average increase is 97 per cent.

PRICES OF BRITISH MACHINE TOOLS IN 1914 AND 1919

Class of Machine	Price in 1914	Price in 1919
14-in. shaping machine	£70	£157
Horizontal boring, facing and milling machine	290	710
20-in. single tool grinding machine	22	39
Metal band-sawing machine	130	214
Hydraulic press	500	1000
Double-end punching and shearing machine	168	386
20-in. engine lathe, Lancashire built, good class	200	420
20-in. lathe	90	180
12-in. lathe, cheap line	26	52
16-in. engine lathe	120	235
17-in. lathe, Yorkshire type, manufacturing	56	92
18-in. lathe, Yorkshire type, manufacturing	65	140
19-in. lathe, Yorkshire type, manufacturing	60	130
Planing machine	180	240
13-in. turret lathe	140	230
8 x 3 x 3 ft. planing machine	245	590
30-in. boring mill	200	270
Hacksawing machine	21	31
9-in. slotting machine	100	196
10-in. slotting machine	80	160
Hand screw machine	58	100
Horizontal boring machine	360	576
Universal tool and cutter grinding machine	65	94
48-in. radial drilling machine	95	200
Combination turret lathe	300	480

Wage Increases and Rates

In 1914 the average wage of a turner (machinist) was from 34s. to 39s. per week according to district, as against from £3 2s. to £3 15s. per week in 1919; that is about 100 per cent. In addition to this increase in wages, the weekly hours have been reduced from 53 or 54 to 47, and a further reduction to 44 is being considered. The current wages at time rates:

Basic wage (Midlands)	£2	6s.	0d.
War advance	1	1	6
Special bonus of 12½ per cent.	..	8	4
	£3	15s.	10d.

For men employed on piece work, a general minimum advance of 10 per cent. on pre-war rates, plus 21s. 6d. per week, has been adopted in the federal machine shops throughout the country. The following table shows the average amount of increase (inclusive of the 12½ per cent. bonus) granted up to the end of April, 1919, on the district time rates for men in certain representative occupations in a number of the principal machine centers, and the equivalent percentage increases over the pre-war rates:

Occupation	Amount of increase per week	Percentage increase on pre-war rates per week
Machinists	37s. 11d.	98
Molders	38 2	92
Laborers	35 5	156

For women in the machinery industry, 18 years and over, not engaged on men's work, the present minimum, including 16s. war advance, is 38s. per week. Higher rates are paid to women engaged on men's work, and to those employed on certain special classes of work.

The question, often asked by American manufacturers as to the relative productive capacity of the British and American workmen in the machine-tool industries, it is impossible to answer accurately without detailed comparisons of actual production. The observation of those who are familiar with conditions in the two countries agree that the general comparison favors our workmen.

A great deal of unemployment exists, particularly in the big munition centers, such as Sheffield, Birmingham and Manchester. The men there are, however, largely unskilled, who have been drawn into the machinery of industry by the war. Skilled men are scarce, and owing to this shortage and other causes referred to the progress of reconstruction is retarded.

The total number of unemployed persons on May 2, according to available records, was 1,093,400 as compared with 1,060,245 on Mar. 28, an increase of 33,155. The total of 1,093,400 was made up of 402,151 men and 1316 women demobilized from the army and navy service, and 689,933 civilians. Of the latter, 452,132 were women

The all-around increase in the price of food since 1914 is well over 100 per cent.

Great apprehension exists in industrial circles over the attitude and requirements of labor, and the resulting uncertainty is paralyzing industrial development. There is no industry or occupation in which stable labor conditions exist. When their labor troubles are settled, British manufacturers expect to see the greatest trade revival of this generation; but if they continue for any considerable period, it is felt that British markets will pass in a large measure to competing countries where such troubles do not exist.

Smith, Fundamentalist

By D. L. Cole

An article on page 179 of *American Machinist* by George C. Hicks, Jr., dealing with a case of mysterious heating in an engine room, has caused me no little wonderment as to what Mr. Hicks was driving at.

I have had considerable experience with steam engines myself, both stationary and marine, and have suffered the usual amount of exasperation and perplexity because of bearings becoming hot without apparent reason; but I do not recall that I have ever before heard of a persistent recurrence of heating due to the deflection of the shaft and its bearings in opposite directions.

I do not understand how such deflection is brought about in a downward direction by the additional or peak load; certainly it could not have been a direct-connected electrical power unit, and large engines delivering their energy through the medium of a belt are not usually located on the roof. The only way that I can figure it out is by assuming a geared drive with the engine running under.

Mr. Hicks says that the trouble was remedied by placing a strut to support the overhanging end of a bearing, but it was the shaft that started all the trouble; was a strut placed under that too? I would be glad to know more of the details of an engine so badly designed as to cause trouble in such a peculiar way.

EDITORIALS

Issue Drawn Against Wage Opportunism

PRESIDENT WILSON through his emphatic stand taken on August 26, in the matter of the demands of the railway shop men, has aligned the Government policy squarely against labor opportunism.

This is the most encouraging news, for the average man, that has come out of Washington for some time, and under the term average man we most emphatically include the average workman.

Low wages are not a boon to the people earning them. The *American Machinist* has never advocated low wages. We have always claimed that the highest possible wage rate is the desideratum. High wages for one thing makes it possible to develop and market improved machinery; where labor is cheap there is little tendency to save it.

But we do emphatically advocate a balanced wage—a wage that is somewhat commensurate with the service rendered and that is not boosted artificially by means of the big stick. There has been a distinct and growing tendency, since the war, for workers who by virtue of their positions think themselves able to take the public by the throat, to demand wages entirely out of proportion to services and thus to increase the cost of living to everybody else.

When this happens we get an unbalanced wage condition. We find the cultivation of brains and the development of initiative gasping in an atmosphere of low purchasing power because less brains, but better organization, has cornered the wage market. What inducement is there to become an average college professor or even an average college president when one has the opportunity of becoming a railroad conductor or engineer? Professional service, should this mad pyramiding of wages continue, would fall into distaste and colleges and universities be obliged to close their doors.

There is just so much purchasing power generated every week and it is measured by the week's production. For one class of people to seize an undue portion of this purchasing power is for a larger majority of people, and most of them workmen, to suffer in consequence. Walker D. Hines, Director General of Railroads, recognized this in his recommendation to the President.

"The way to reëstablish the pre-war purchasing power of wages is to reduce the cost of production and not to increase it. The Government is now taking vigorous steps to reduce the cost of living and is meeting with gratifying progress. This great work would be arrested, if not defeated, through the present adoption of the policy of moving up wages so as to reflect fully what is probably the very top-notch of the high cost of living. Such a movement would tend to increase still further the cost of living and injure every working man as well as every other person in this country."

And the President recognized this in his statement to the public:

"In such circumstances it seems to me, and I believe will seem clear to every thoughtful American, including the shopmen themselves when they have taken second thought, and to all wage earners of every kind, that we ought to postpone questions of this sort until normal conditions come again and we have the opportunity for certain calculation as to the relation between wages and the cost of living. It is the duty of every citizen of the country to insist upon a truce in such contests until intelligent settlements can be made, and made by peaceful and effective common counsel. I appeal to my fellow citizens of every employment to coöperate in insisting upon and maintaining such a truce, and to cooperate also in sustaining the Government in what I conceive to be the only course which conscientious public servants can pursue. Demands unwisely made and passionately insisted upon at this time menace the peace and prosperity of the country, as nothing else could, and thus contribute to bring about the very results which such demands are intended to remedy."

At last we seem to be in sight of the turning point. This action of the Administration, while it will unquestionably be bitterly contested by individuals who put selfishness above public good, will bring a great moral force to bear against class profiteering through wage opportunism and strengthen the hearts and hands of those who have been waging a one-sided battle against it.

U. S. Exports Decreasing, Imports Increasing

THE total exports from the United States for July were the smallest for any month of 1919. They amounted to $570,000,000, which was nearly $350,000,000 less than June. On the other hand our imports broke all records. They amounted to $345,000,000, against June's previous high record of $293,000,000.

This reversal of the trend of trade may be surprising to many people who are aware of the emptiness of European industrial cupboards and who have prophesied enormous export trade due to reconstruction needs. The needs are as pressing as ever, but unfortunately the money is not available with which to fulfill these needs. England, for example, is practicing economy in its purchases in order to avoid financial disaster. All other war-stricken nations must do likewise.

Fortunately, it is probably that a considerable amount of this reduction on the part of our foreign customers is in products which might be classified as luxuries and non-essentials. Machinery exports are going well. The world can well afford to trim some of the nonessentials so long as it does not become penurious in procuring things that it really needs and that will be of benefit. Financiers would say that this decrease in our exports is due to the decrease in the value of foreign money. The pound Sterling, for example, is now at a point which requires foreign purchasers to add a considerable percentage above par to secure commodities from America. This is another phase of price raising. Nobody likes to buy at increased prices and an Englishman or

Frenchman naturally hesitates to pay these increased prices in the form of exchange just as much as he would if the prices in dollars had been marked up.

In the last analysis it amounts to the fact that those who have money buy. Uncle Sam happens to be the biggest buyer today.

No Profiteering Among Machinery Builders

THE importance of the machine shop as a national factor did not become broadly apparent to the American public until the war. Then everybody learned of the importance of metal-cutting machinery, and read astonishing figures about the amount of the equipment needed by munition plants. Popular opinion probably has been that in view of such an increased demand for machinery, there would naturally have been considerable inflation in price.

The average price of machine tools today is approximately ninety per cent. more than it was in 1914. During the same period, food and clothing increased in Chicago, 157.67 per cent.; in Detroit, 125 per cent.; in Cleveland, 140 per cent.; in Boston, 151 per cent.; and in New York, 135 per cent. Machine tools are largely city productions, and both wages and cost of materials have advanced at least in proportion to the cost of living, where they are made. Machinery builders have handled a large volume of business but it is evident that they have not capitalized public need for their own benefit.

One Way of Aiding Production

THIS is a time for cool and careful thinking and acting. The spirit of unrest is the natural result of war and the conditions which it brings in its train. While wages and the cost of living are in the foreground, they are by no means the only factors to be considered.

The great need of the times for this country and all others, is *production*. And this whether prices be high or low. Anything which hinders production—no matter how remote it may seem to be—is a menace to the welfare of the country and of the world.

The widespread belief in the profiteering in food, apparently borne out by the increasing supply in cold storage as well as in increasing prices, has a direct influence in restricting production in other lines. For men cannot and will not produce at even a normal rate when their minds are in a turmoil and in revolt at what seems to be the attempt of certain groups to profit by the necessities of the times. The thinkers among the labor group realize that increased wages do not solve the problem—but until these questions are in a fair way to settlement, we must not expect full production in any line. Unsettled minds directly interfere with securing the best results.

Never was there a time when we all had more in common than at present, or more common ground for getting together. Never was there a better opportunity of showing how closely the welfare of the men and of the shop were bound up together.

Manufacturers desire a stabilization of the wage question. Workers desire a decrease in the cost of living. Production helps both of them to attain their ends. There is evidence that employees and employers are beginning to see this point of common interest. The bread-and-butter question is a vital one to the employee. Being so, it becomes vital to the employer who looks forward to the ceasing of the wage-pyramiding program. It would appear to be a wise and politic move for the employers to aid in the campaign to eliminate profiteering from food and clothing. The increase of these two commodities has caused probably 90 per cent. of the discontent that exists today. Manufacturers of metal products and machinery will find it to their advantage to aid in every possible way the securing of lower prices for food and clothing.

Consideration of the human side of shop relations—a getting together with the men on various questions of production of shop policy and kindred matters, may do much to smooth out difficulties while they are still small. Prevention is much easier and better than after the disease develops.

We can help along this line and we can do no better work for ourselves or for the country than by preventing delays if not stoppages in production.

Clean and Dirty Money

THE more we see of some other professions, the more gratified we are to be a part of the great producing fraternity, the brotherhood that earns its money cleanly; not by cornering food supplies nor gambling in stocks but by making machinery—adding something real and honest to the world's wealth.

This thought was brought home very strikingly upon a perusal of the latest effusion of Thomas W. Lawson of copper stock notoriety. Lawson has turned from copper to silver, and is now attempting to kite silver mine stock ostensibly for the benefit of the American public. Some of his statements are enlightening:

"Today the principal industry of the American people is Gambling—Stock Gambling. The making of wealth from nothing.

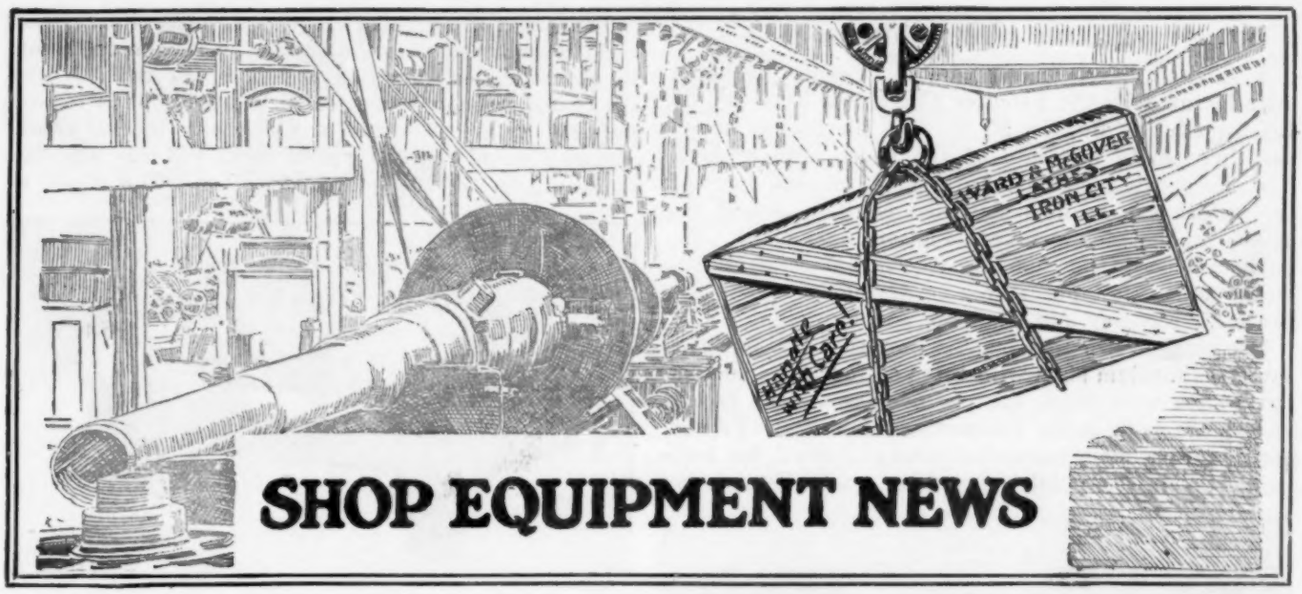
" . . . when I predicted one-quarter of the above prices for 'Coppers,' my critics held forth on my mental condition and yet while the criticism ink was yet damp my predictions were verified four times over and the public was four hundred million dollars richer."

Four hundred million dollars from nothing! This beats the creation of wealth through the manufacture of products. What chance have you honest builders of machinery and operators of machines to secure lower costs of living as long as the prices of raw materials can be kited by men of Lawson's stamp?

A Thought for Today and Everyday—Quality

SCARCELY a day passes without one hearing the saying: "This —— is not as good as it used to be." Increasing prices, it would seem in a good many cases, have been balanced by proportionately decreasing quality; when one stops to think this is as might be expected. Increasing prices mean greater demand. Greater demand brings with it the temptation to slouch.

The enduring successes among plants in the machinery-building world have all been built and maintained by sticking to quality first, last and all the time. We cannot build enduring success without quality. Give up your quality ideal the day after you give up your business—if you must give up—but not before!



SHOP EQUIPMENT NEWS

Baker Horizontal Drilling and Boring Machine

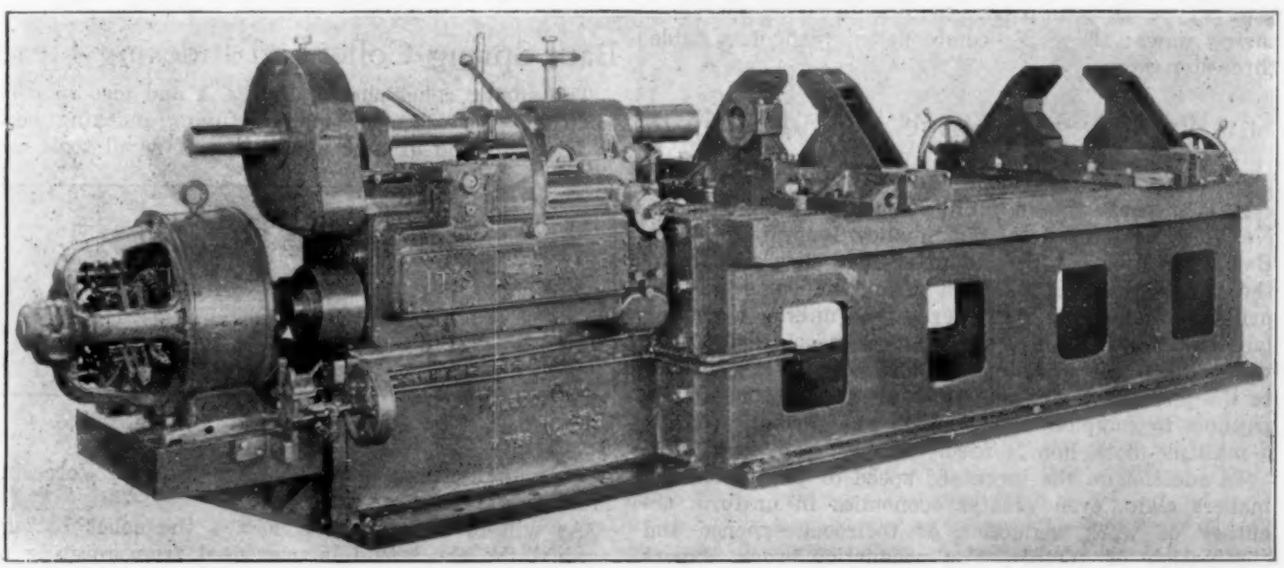
The machine shown is made for heavy-duty work. It was originally built for one of the large railroad shops for drilling locomotive axles and crankpins, but it is adapted to many other jobs outside of the railroad shop. It is made by Baker Bros., Toledo, Ohio, and will be furnished as a regular machine known as the No. 519 horizontal heavy-duty drilling and boring machine. Such work as drilling connecting-rods for emergency fleet engines can be handled to good advantage and a large production secured.

The spindle is carried in a stiff, rigid, heavily designed head allowing the machine to work at high speeds and coarse feeds. The construction of this spindle gives the machine capacity enough to drive 5-in. high-speed drills to the limit of their efficiency in steel. The machine can also be used for boring and enlarging holes in steel and cast iron up to 14 in. in diameter.

A constant-speed drive is secured through a train of hardened gearing running on annular ball bearings, all incased in an oil-tight box. The driving motor is set on a bracket off the floor and belted direct to the speed box. A 15-hp. 1200-r.p.m. motor is used and when installed with a push-button starter, makes an ideal drive which can be operated easily. All operating levers are located so as to be handled conveniently by the operator when in working position. Change of speed is quickly made by means of sliding gears. Eight speeds ranging from 11 to 151 r.p.m. are available.

The feed is simple and rugged, yet 12 drilling and 12 reaming feeds are provided. The machine is also equipped with a reversing tripping box, giving an automatic back feed. This is a feature which is quite useful on a machine of this type as it is often necessary to bore through work and face or counterbore on the back side.

The work table is designed with ample working surface and is heavily braced, well ribbed and equipped with T-slots for clamping fixtures and work. It also has deep side grooves for the cutting lubricant supplied from an attached pump.

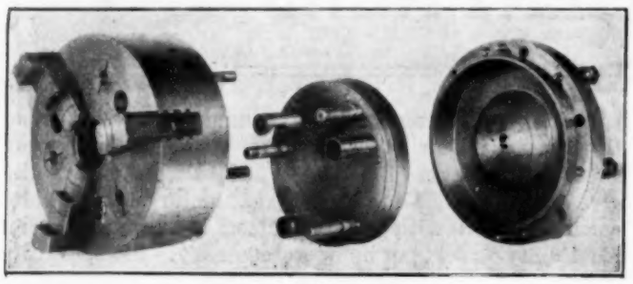


BAKER HORIZONTAL DRILLING AND BORING MACHINE

Lavoie Air Chuck

A new air chuck known as the "Lavoie" is being manufactured by the Frontier Chuck and Tool Co., 36 Letchworth St., Buffalo, N. Y. The illustration shows the three main elements of the chuck disassembled. The chuck, when assembled, forms a compact, inclosed unit which can be applied to the working end of the spindle in the same manner as an ordinary chuck. No gears are used, the clamping mechanism being of the wedge and lever type. A release spring is used to improve air economy and eliminate double piping.

The smaller sizes are made with either two or three jaws, the medium sizes with three or four jaws and the large sizes with three, four or five jaws. The Lavoie chucks are made in the following seven types: Type 1, for horizontal clamping and chucking; Type 2, for horizontal clamping and pilot boring-bar guide; Type 3, for



LAVOIE AIR CHUCK

horizontal clamping and bar work; Type 4, with base, for vertical clamping and chucking on machines without rotating the chuck; Type 5, with hollow center and base, for vertical clamping and chucking on machine without rotating the chuck; Type 6, with base, for vertical clamping and chucking on machines where chuck will rotate; Type 7, with hollow center and base, for vertical clamping and chucking on machines where chuck will rotate.

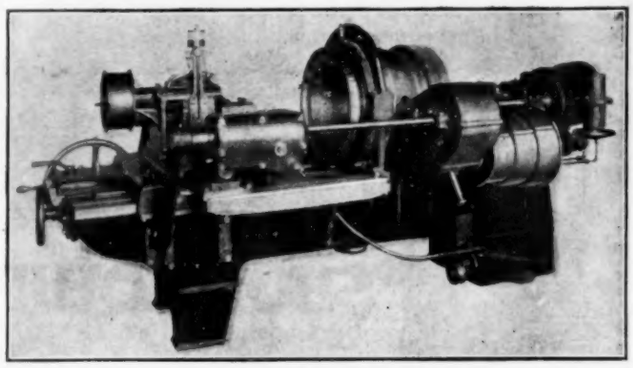
Six different types of jaws can be furnished as follows: Type A, universal with solid manufacturing jaws; Type B, universal with detachable manufacturing jaws; Type C, combination with solid three-step jaws; Type D, combination with solid manufacturing jaws; Type E, combination with detachable manufacturing jaws; Type F, combination with detachable three-step jaws.

Smalley-General Flange-Thread Milling Machine No. 1

A new flange-thread milling machine designated as No. 1, is announced by the Smalley-General Co., Inc., Bay City, Mich. A three-quarter rear view appears in the illustration. It is built upon the same general principle underlying the other thread milling machines built by this company. During one revolution of the work, the milling head is withdrawn a distance equal to the pitch of the thread to be milled, thus making it possible to complete the work in one revolution when a multiple-tooth hob is used.

In addition to the increased speed of production the makers claim even greater economies in uniform accuracy of work, reduction of toolroom expense and elimination of scrap. For production work, expert labor is not required.

The taper attachment is exceptionally heavy and rigid to make possible the completion of the operation in one combined roughing and finishing cut. Where the customer has compressed air available, it is recommended that the machine be fitted with the air chuck designed for it. Either type of chuck will take any size flange up to 23½-in. outside diameter. The chuck is



SMALLEY-GENERAL FLANGE-THREAD MILLING MACHINE

Capacity, up to 16-in. inside diameter threads with 3-in. diameter hob; swing over bed, 27-in. diameter; maximum distance from face of chuck to end of milling spindle, 24 in.; gears furnished for 11½-, 10- and 8-pitch threads, others can be furnished extra if desired; machine furnished with three milling speeds, maximum speed 1½ times minimum speed; floor space occupied, 5 ft. 9 in. in width by 11 ft. in length; main spindle countershaft speed to suit work, 12 x 5-in. tight and loose pulley, 5-in. belt to machine; milling spindle countershaft speed to suit hob diameter, 12 x 5-in. tight and loose pulleys, 5-in. belt to main head and 4-in. belt to milling spindle; standard taper in milling spindle, No. 13 Brown and Sharpe; taper attachment is provided; approximate horsepower required, 5 to 7, depending on work; weight, approximately 8300 lb., net, exclusive of countershaft.

threaded to the main spindle which is driven from the three-speed countershaft by a staggered-tooth gear on the spindle and pinion mounted on a 3:1 back gear shaft.

For facing the flanges, a power-feed attachment giving feeds of $\frac{1}{16}$, $\frac{1}{8}$ and $\frac{3}{16}$ in. is fitted. It can be reversed and is provided with trips so that it can be thrown out when the tool has traversed the proper distance. Cutting speed runs at about 50 ft. per minute.

An oil pump and reservoir are supplied to supply a stream of lubricant to the hob. In setting up flanges they are chucked with the finished face out so that the facing and threading operations are performed with one setting.

Bath Spring Collet and Indexing Head

The spring collet shown in Fig. 1 and also in combination with a special manufacturing indexing head in Fig. 2 is the first of a new line of small tools and

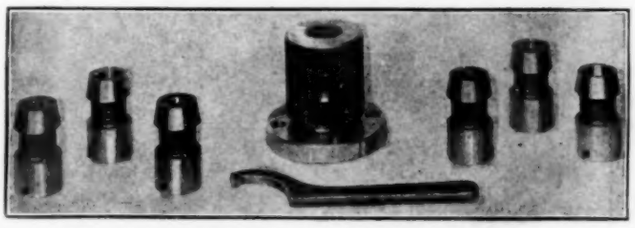


FIG. 1. BATH SPRING COLLET

gages manufactured by John Bath & Co., Inc., Worcester, Mass.

As will be evident from Fig. 1 the collet bottoms against the chuck and is prevented from rotating by a pin in the plate which engages a notch in the collet

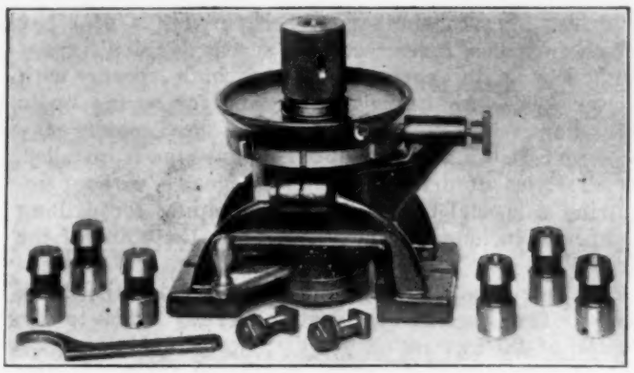


FIG. 2. BATH INDEXING HEAD

skirt. There is consequently no tendency for the collet jaws to pull back on the stock. The knurled nut compresses the collet jaws as it is drawn down on the conical surface by the threads.

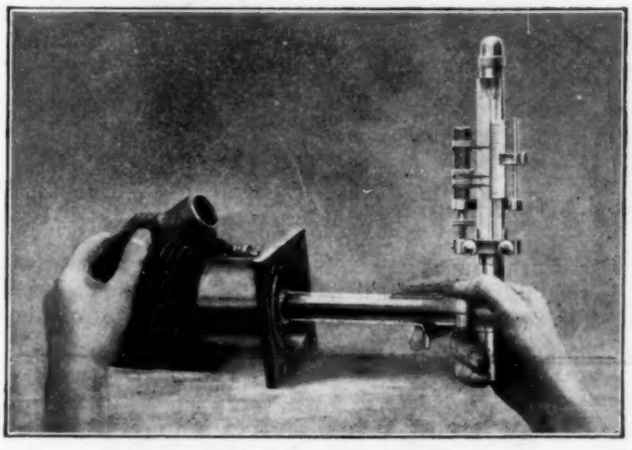
This arrangement permits the handling of stock up to the full size of the opening of the collet. The largest collet of the set is made to take stock 1¼ in. in diameter. The chuck can readily be fitted to any lathe faceplate.

In Fig. 2 the same collet chuck is shown fitted to an indexing head that is provided with separate notched cast-iron index plates. Release of the stop pin allows the work to be indexed by the handle shown which actuates a ball ratchet.

The index plates are simple and so cheap that for manufacturing work a separate plate can be made for every job. They are also time-savers on jobs where uneven spacing is required as the notches will be cut according to the requirements and the plate can be indexed by sense of touch without looking to be sure the right point has been reached. The equipment includes a spanner and six collets.

Coats Cylinder Bore-Testing Gage

The Coats Machine Tool Co., 110 West 40th St., New York, has combined its Prestometer fluid micrometer gage with another mechanism in such a way as to produce a gage for testing the bore of automotive cylinders. This device is shown in the illustration. In general the gage is constructed in this way: A large hollow plug containing a fluid chamber is made so as to go easily into the cylinder to be measured. The fluid chamber has a metal diaphragm against which a contact pin presses. This contact pin follows the inside surface of the cylinder as the plug is inserted and moved around inside it. Any rise or depression in the cylinder wall is registered on the diaphragm by the contact pin, and causes a variation in the height of the fluid column in the gage outside, to which the fluid chamber is connected by a tube. In order to accommodate this gage to various sizes of cylinders, additional plugs, packing pieces or rings may be attached to the outside of the fluid chamber when desired.



COATS CYLINDER BORE-TESTING GAGE

Fosdick Heavy-Duty Upright Drilling Machine

The Fosdick Machine Tool Co., Cincinnati, Ohio, has added to its product a line of upright drilling and tapping machines. The gearing arrangements, frictions, feeds, "quick return," and other features are similar in detail to the corresponding parts used on the Fosdick heavy-duty radial drilling machines.

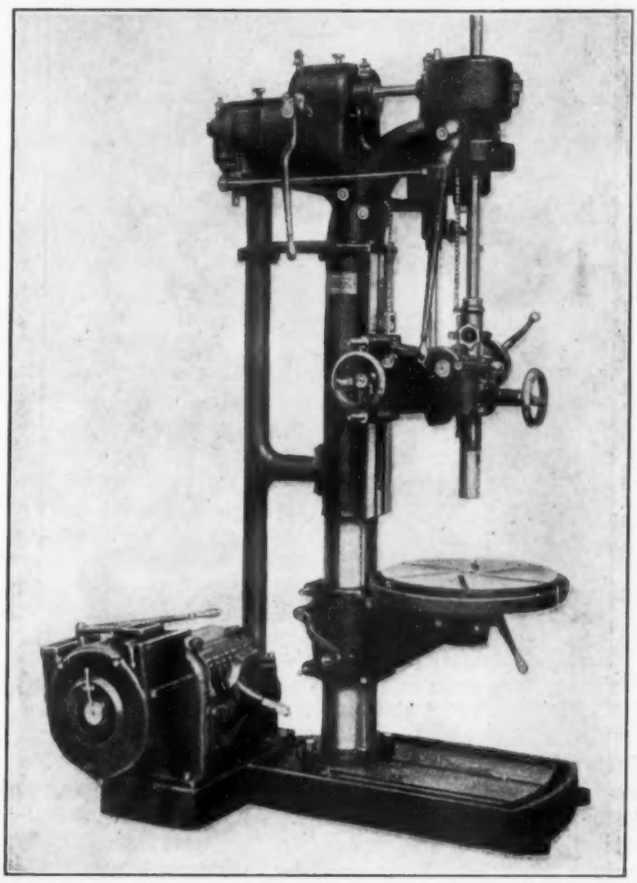


FIG. 1. FOSDICK UPRIGHT DRILLING MACHINE WITH BELT DRIVE AND ROUND TABLE

The base is surrounded by a channel draining to a large reservoir for drilling compound, and is so designed that bolts may be entered from either end of the T-slots. The table arm has an unusually long bearing on the column and is internally ribbed similar to a bridge or roof truss, which greatly increases the rigidity. The table may be raised or lowered from either side of the machine; it may be swung around the column to clear the base for large work and cannot accidentally drop when unclamped. The unique arrangement of the T-slots on the round table allows them to terminate very

close to the center; allows heavy ribs to run directly toward the hub; permits work of any shape to be securely clamped, and prevents bolts from flying out should they become loosened while drilling. Tilting, square or compound tables may also be supplied.

The spindle head is raised and lowered by a handwheel, and, not being burdened with the heavy feed arrangement, is perfectly counterbalanced. The spindle is provided with depth gage and automatic trip which may be set to graduations in any position in the entire length of travel. A safety trip at the limit of travel prevents accidents. The spindle "quick return" acts

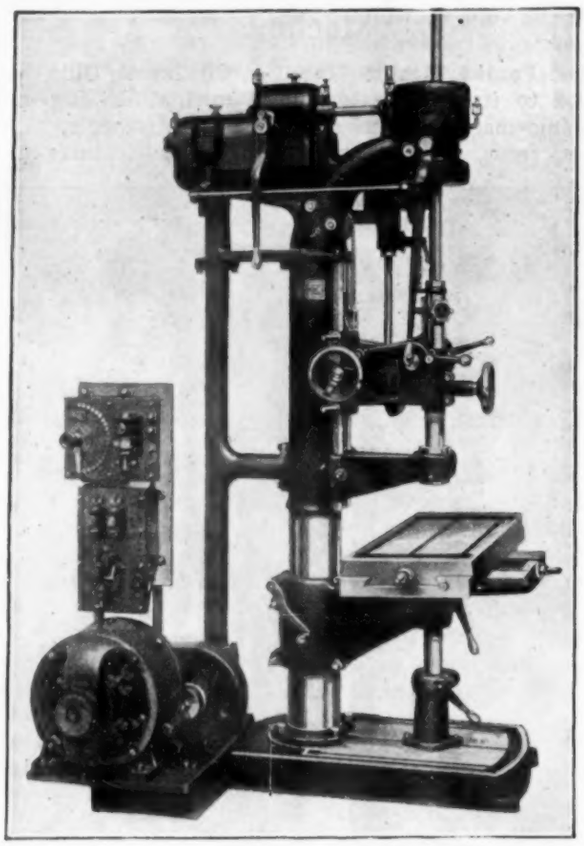


FIG. 2. FOSDICK DRILLING MACHINE WITH MOTOR DRIVE AND COMPOUND TABLE

instantly and requires but one hand to operate. For sensitive drilling, for tapping, or for rapid lowering or return of the spindle, it may be operated with or without disengaging the power or handwheel feed. The power feeds are all obtained by moving a single lever, within easy reach of the operator while seated, although it has been placed high enough not to interfere with the operating levers on the head. The hand feed may be used to feed ahead of the power feed without disengaging the latter. This is particularly advantageous in starting large drills.

A friction reverse tapping mechanism is embodied in the construction of all machines, and is placed between the initial drive and the back gears. The bronze bearing bushings are pressed into bored holes, no babbitt metal being used in the machine. Ball bearings take the principal thrusts including the spindle, both crown gears, the vertical driving shaft and friction bevel pinion, the feed worm and the feed bevel gear.

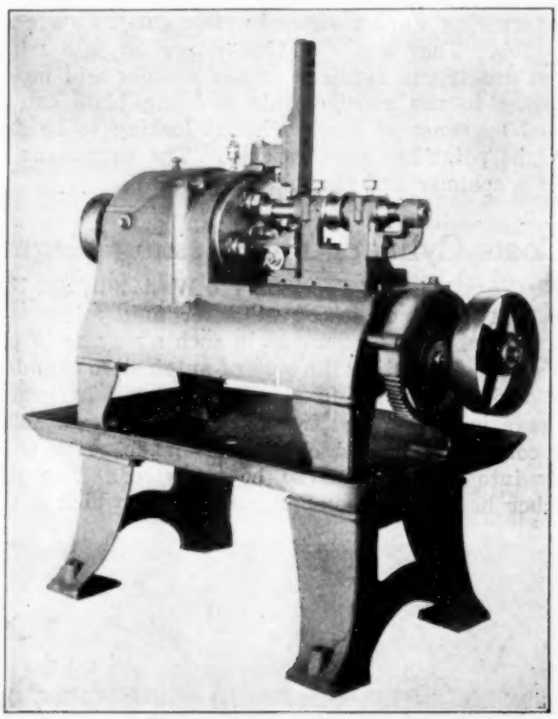
A metal chart showing speeds and feeds for high-speed work is attached to each machine. The machine is driven by a constant-speed belt through a gear box which furnishes correct cutting speeds for drills ranging from $\frac{3}{16}$-in. carbon to 2½-in. high speeds with slower speeds for heavy tapping and for boring up to 5-in. diameter. Constant- or variable-speed motors may be supplied even after a belt-driven machine is installed, as all styles of drive are interchangeable without requiring a special base. Pump and piping for drilling compound includes the flexible tube to the point of the drill.

The machines shown in Figs. 1 and 2 are the 25-in. sizes. The general specifications are: drills to the center of 25 in.; maximum distance, spindle to base, 49½ in.; maximum distance, spindle to table, 33¾ in.; spindle takes No. 4 Morse taper shanks; twelve spindle speeds, 49 to 550 r.p.m.; five geared feeds, 0.004 to 0.028 in. per revolution of spindle; net weight, about 2350 lb.; power required for average work, 3 to 5 hp.; power required for continuous maximum performance, 7½ horsepower.

Kent Nut Semi-Finishing Machine

The Kent Machine Co., Kent, Ohio, has brought out the nut semi-finishing machine shown in the illustration with a capacity for nuts up to ½-in. size.

The machine is a four-station horizontal-turret type with hand-loaded magazine feed. At the first turret station the nut is taken from the feed and screwed



KENT NUT SEMI-FINISHING MACHINE

on the revolving spindle. In the second turret station the roughing cut is taken. The third station is used for the semi-finishing cut while at the last station the nut is automatically removed.

As the nut is revolved upon its own axis, the chamfer is essentially concentric with the axis of the screw thread, thereby making the work exceedingly accurate. There is no starting or stopping of the turret spindles

which accounts for the large production which may be obtained from this machine.

The turret spindles are made of nickel steel and run in tapered adjustable bearings made of special alloy bronze. All gears in the turret head are made of steel and are well inclosed. The complete machine weighs about 3000 lb.

Greaves 24-In. Geared-Head Lathe

The Greaves Machine Tool Co., Cincinnati, Ohio, has recently put on the market a 24-in., single-pulley-drive, geared-head engine lathe shown in Fig. 1. Special attention to the construction of the machine has been given so as to make it adaptable for both light and heavy work.

The apron is of box form and the side and rear walls are cast integral, the front plate being removable as shown in Fig. 2. All gears can be exposed, or removed by taking off the front plate without dismantling the apron from the machine. The gears are of steel and all studs and gears are supported at both ends.

The longitudinal and cross feeds are independent of each other and are operated by positive clutches. Both can be engaged at the same time. The feeds and lead screw are reversed in the headstock by a lever operating at the right side of the apron.

The lead screw and feed rod are supported at both ends of the apron, preventing any strain on the gearing that may be caused by the sagging of the lead screw and feed rod. The ratios of lateral and cross feeds to lead screw are 10 to 1, making it possible to cut scrolls or spirals from 5 to 280 per inch with the feeds which can be read directly from the index plate on the gear box. Special or coarser scrolls or spirals may be cut by changing the outer gears on the quick-change box.

Engaging the lateral and cross feeds simultaneously causes the tool to follow a path forming an angle of 45 deg. with the center line, or 24 in. taper per foot. By using the taper attachment in conjunction with the two feeds, the angle can be increased or decreased to form a maximum of 30 in. per foot, or a minimum of 18 in. per foot. The bed is deep and is heavily braced with box-section girths which extend the full depth of the bed. In addition to the cross girths a double wall brace is cast lengthwise in the center of the bed, extending its full length.

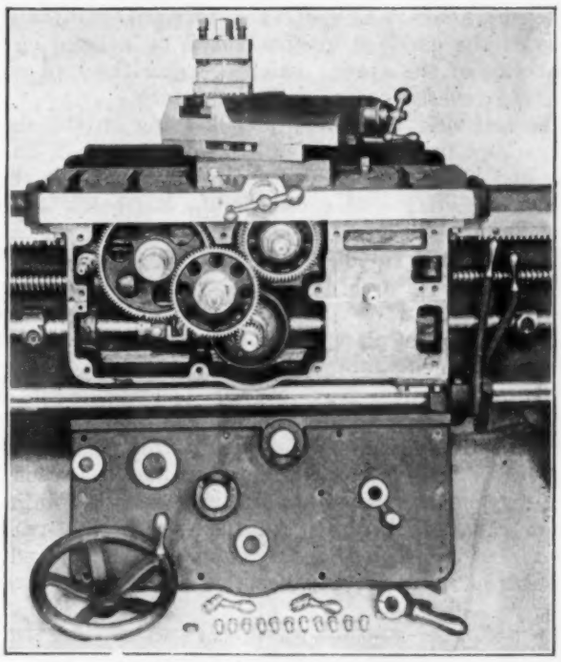


FIG. 2. SHOWING REMOVABLE FRONT APRON PLATE

The carriage has a full-length bearing on each V and a wide flat bearing on the inside front V. It is also provided with an additional 15-deg.-angle bearing the full length of the carriage which prevents the carriage from creeping when taking heavy cuts. Felt wipers are provided in the ends of the wings for the V's and also for the flat bearing. The carriage has an oil trough around the front and rear wing which delivers cutting lubricant to the center of the bed. A chasing dial is provided for thread cutting which can be dis-

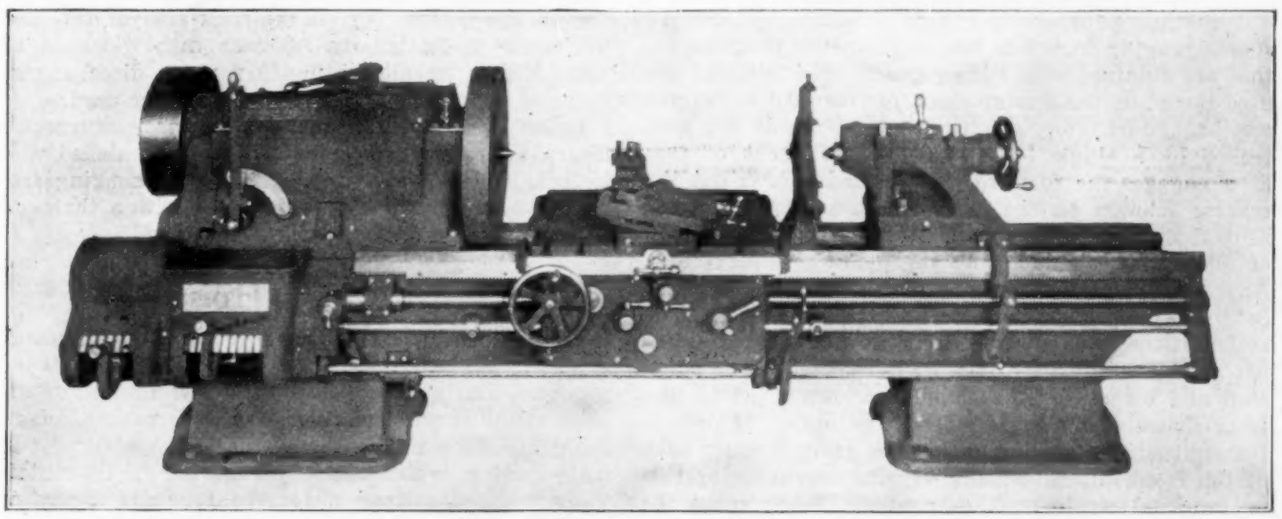


FIG. 1. GREAVES 24-IN. GEARED-HEAD LATHE

Dimensions: Swing over ways, 27½ in.; swing over carriage, 18 in.; takes between centers, 4 ft. 10 in.; front-spindle bearing, 5½ in. diameter, 8 in. length; rear-spindle bearing, 3¾ in. diameter, 5¾ in. length; hole through spindle, 2⅛ in.; diameter of driving pulley, 20 in.; face of driving pulley, 6½ in.; width of belt, 6 in.; number of spindle speeds, 12; range of spindle speeds, 8, 280; speed of driving pulley, 336 r.p.m.; taper of centers, No. 5 Morse; tailstock spindle, 3¼ in. diameter, 23 in. length; tailstock-spindle travel, 13½ in.; length of carriage bearing on bed, 39¾ in.; carriage bridge width, 11½ in.; lead screw, 2 in. diameter, 2 threads per inch, right-hand Acme; feed rod, 1¼ in. in diameter; cut threads, ¼, 28; feeds, 5, 280; apron ratio, 10-1; compound rest travel, 8 in.; size of lathe tool, 1 in. x 1¼ in.; bearing of tailstock on bed, 20 in.; spindle nose, 6¼ in. diameter, 1¼ in. length; spindle nose pilot, 4 in. diameter, 2¾ in. length; motor horsepower, 7½, 10; motor speed, about 1200 r.p.m.

engaged when not in use. The forward, stop and reverse of the carriage are controlled by a lever on the right side of the apron, which operates the lead screw and feed reverse gears in the headstock.

The tailstock has a very long bearing on the shears and is kept in alignment with the head by a V on the rear and has a large flat bearing on the front shear. A pawl engaging with a rack in the bed holds the tailstock against the end thrust.

The tailstock spindle is clamped downward by two clamp plugs spaced 7 in. apart, which are operated by a single lever. It is claimed that clamping the spindle in two separate places avoids springing the spindle out of alignment.

The quick-change gear box, Fig. 3, is a separate unit mounted on the front of the bed and contains all the mechanism for making 54 screw threads and feed changes. Threads from 2-in. pitch to 28 threads per inch may be cut. Two handles are used to obtain the entire range of threads and feeds. A direct-reading index plate is located on the front of the box and the tumbler handles are easily accessible to the operator.

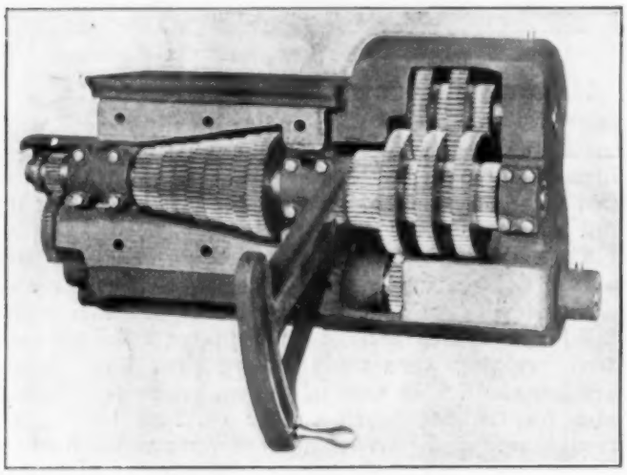


FIG. 3. REAR VIEW OF QUICK-CHANGE GEAR BOX

The single-pulley-drive geared head, Fig. 4, has 12 speeds ranging from 7 to 300, in geometric progression, that are obtained with sliding gears. No frictions are used except on the driving shaft for forward or reverse motion. Start, stop, and reverse and speeds are controlled by a single lever. Inward movement of this lever engages the forward friction and throws out the reverse friction on the drive shaft, and when placed neutral disengages the frictions relieving the gearing of all strains, and allowing the gears to slide freely. Any speed may be obtained while the machine is under cut by a right or left movement of the same lever. The action of the lever is self-locking so that the gears cannot be shifted until the friction is released. The start, stop and reverse of the spindle are controlled by the lever shown at the right side of the apron. Power is transmitted to the spindle through gears directly back of the front-spindle bearing, eliminating any vibration or torsional strain on the spindle. The lever at the front of the headstock engages the spindle direct or through the back gears, and it also has a neutral position which permits revolving the spindle by hand for chucking or similar work.

The gears are made of chrome-nickel steel, pack-hardened and heat-treated, and the bearings are bronze

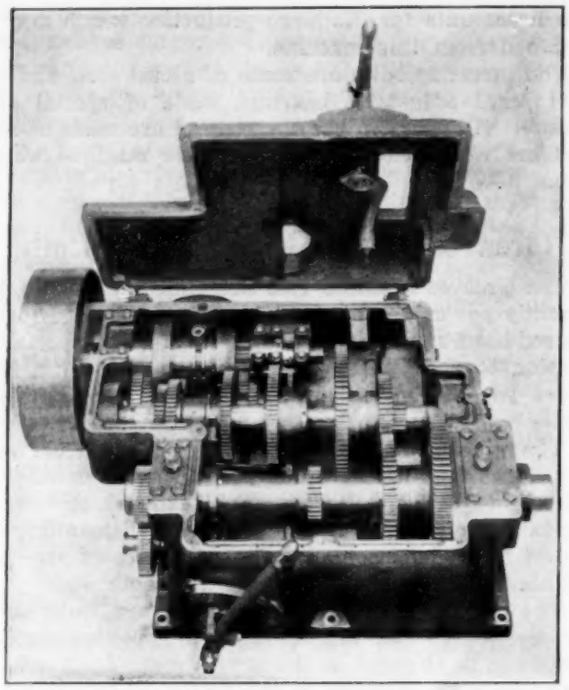


FIG. 4. SINGLE-PULLEY-DRIVE GEARED HEAD

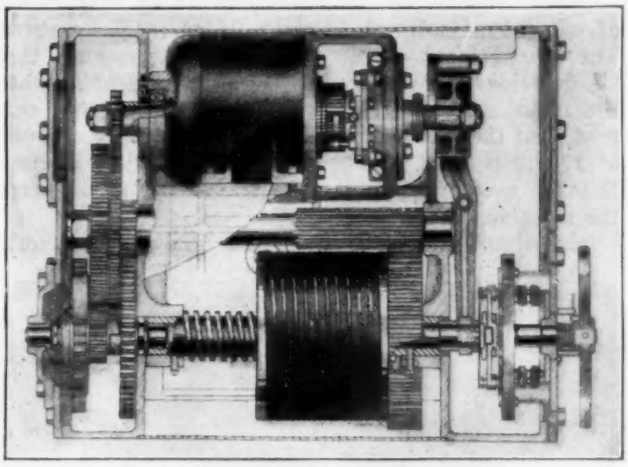
bushed and run in an oil bath. The spindle has a double-size nose, the smaller diameter being made to a standard size and acts as a pilot to the chuck or faceplate. The large diameter is threaded and the front face or shoulder is of ample width and ground accurately at right angles to the small diameter. The chuck or faceplate is piloted to the threads by the small diameter and when drawn up against the shoulder, the front face of the large diameter trues up the chuck or faceplate accurately.

Attention is called to the fact that as the ratio of the gearing in the head is very high and the strain on the drive shaft is comparatively light, a pivoted motor belt drive is recommended. The motor which acts as a belt tightener is attached to a bracket which is pivoted in the cabinet leg on the back side of the lathe and exerts 80-lb. tension for each inch width of the belt. Either an alternating-current or direct-current motor of approximately 1200 r.p.m. may be used.

Taper attachment, turret on carriage, turret on shears, and other attachments may be furnished when desired. These lathes are built in sizes ranging from 18- to 30-in. swing and are also built with a three-step cone and double-friction back-geared head.

Browning Hoist

Victor R. Browning & Co., Cleveland, Ohio, announces a hoist, designed for the severest kind of industrial service. The general shape and low design of this hoist adapt it particularly for use where headroom is limited or the available space otherwise restricted. The main casting, which carries all moving parts, contains individual compartments for the four units, any one of which can be quickly removed if desired. In one end of the casting, heat-treated gears and the disk load brake are assembled and revolve in oil. At the reverse end, the controller and the motor shaft are carried in another individual compartment. The entire controller may be quickly removed for inspection or repairs, and



BROWNING HOIST

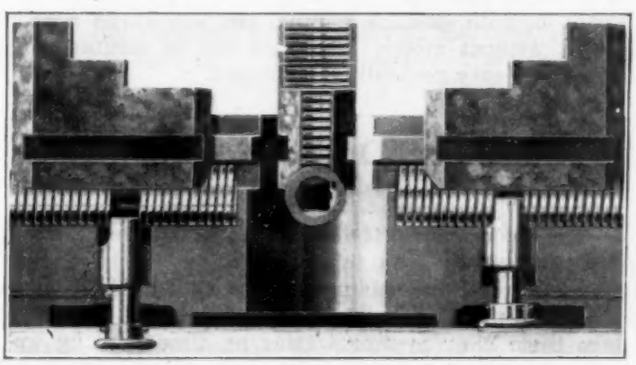
the removal of a plate gives access to the gears and load brake. Between the gear and controller units are two long compartments, one of which contains the motor and the other the hoisting drum. The drum is carried on a threaded shaft and travels longitudinally while rotating. This feeds the cable through a bushing in the main housing and directly into the drum groove in rewinding. It is claimed that this adds considerable to the life of cables and maintains perfect balance.

Simple but dependable limit attachments are installed at the ends of the drum shaft to prevent overtravel of the drum in either direction. All bearings are large and bushed with phosphor bronze with the exception of the motor, the shaft of which revolves on ball bearings. Two of the bearings are provided with grease cups while the other four are lubricated by splash from the gears. This hoist is furnished with a specially designed motor, either direct current or alternating current, and provision can be made for suspending it from an overhead trolley, I-beam or any kind of fixture.

Dayton Quick-Change Chuck

The Dayton Reliance Tool and Manufacturing Co., Dayton, Ohio, has just put on the market the chuck illustrated which is fitted with a device for changing the jaws quickly. As will be seen from the sectional view of the chuck shown the removable screw is held in by a plunger located by a ball check. When this plunger is withdrawn the jaw and screw can be slid out as a unit and reversed. In addition to reducing appreciably the time of changing the jaws, this arrangement provides an easy method of cleaning the jaw and screw without danger of injuring the threads. The plungers are self-locking and the screws have squared openings in both ends.

These chucks are made in seven sizes, from 8 to 18 in. in diameter.



CROSS-SECTION OF DAYTON QUICK-CHANGE CHUCK

Brown Improved Heatmeter

The Brown Instrument Co., Philadelphia, Penn., has secured the sole manufacturing license for the new type of pyrometer or heatmeter shown in the illustration. The meter was developed and patented by Messrs. Harrison and Foote of the Bureau of Standards and

BROWN IMPROVED HEATMETER

incorporates a feature which is claimed to make the readings independent of the distance between the thermocouple and the instrument. This consists of a rheostat which cuts in a resistance equal to and balancing the resistance of the thermocouple and the leads. With the instrument connected the operator has only to note the reading, press the key on the left-hand side of the instrument and again note the reading. If the two readings do not agree he turns the adjusting knob on the top of the rheostat until the internal resistance balances the external and the two readings become the same.

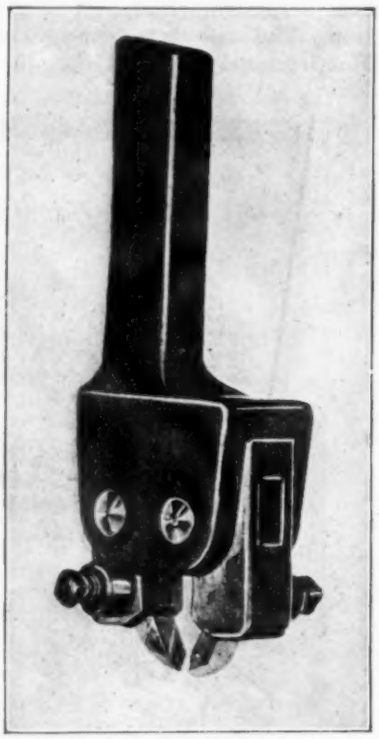
Flather 7-Inch Manufacturing Lathe

Owing to the fact that a wrong illustration was placed with the brief description of this lathe in our Condensed Clipping Index of Equipment section on page 444a, we have printed it again on page 494a with the correct illustration. If our readers will paste the correct clipping over the first, it will avert confusion.

Cronau "Both Ways" Planing Tool

A tool, designed to cut on the return as well as the forward stroke of the planing or shaping machine, is being made by Otto H. Cronau of 330 East 87th St., New York City.

The body of the tool is a drop-forging of mild steel, pack-hardened. Two small swinging holders are carried in the body, each with a square hole broached through it to take a standard high-speed-steel toolbit. These holders are pivoted upon substantial tool-steel pins, and are arranged to act in the same manner as the clapper on a shaping machine, one holder being so set as to lift on the forward stroke of the machine and the other on the return stroke.



CRONAU "BOTH WAYS" PLANING TOOL

The holders are joined together by a link at the upper end so that as one swings down to cutting position the other is lifted and there is no dragging of either tool point on its idle stroke.

In practice the toolbits are so set that a roughing cut is taken on the outward or slower stroke of the machine and a finishing cut on the return or fast stroke; thus two cuts are taken over a piece in the time required for one traverse.

If it is desired the tool points may be so set that both cut in the same plane, and the feed of the tool doubled. The clapper of the machine is of course strapped back or otherwise held while this tool is in use. The tool is being made in two sizes with shanks 1 in. x ½ in. and 1¼ in. x ⅝ in.

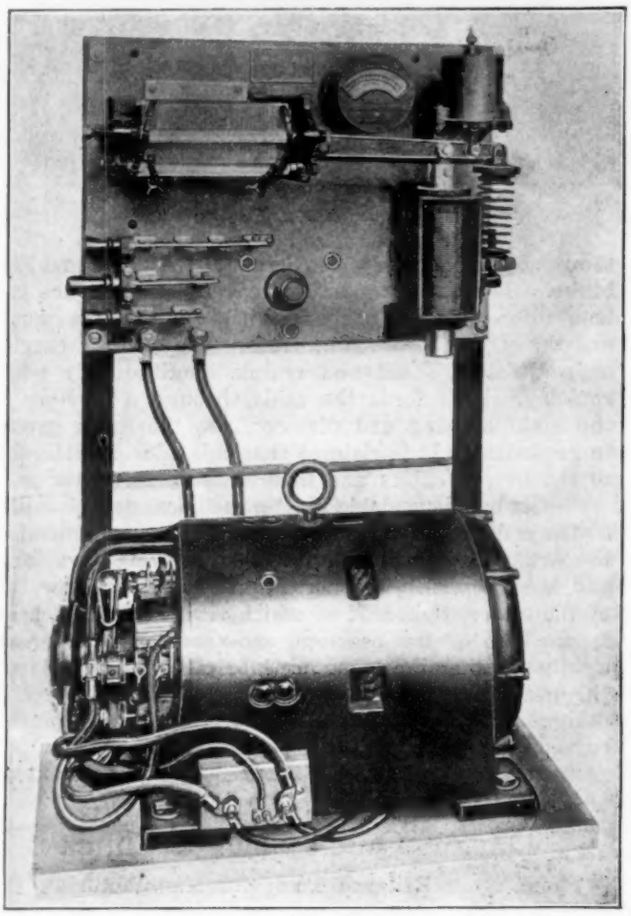
"Plastic-Arc" Welding Unit

The "Plastic-Arc" welding unit illustrated has just been brought out by the Wilson Welder and Metals Co., 2 Rector St., New York. This set is composed of a dynamotor and current control panel. The generator is flat-compound wound, and maintains the normal voltage of 35 on either no load or full load.

The control panel has been designed to provide a constant-current controlling panel, small in size, of light weight, simple in operation and high in efficiency. The panel is of slate, 20 in. x 27 in., and on it are mounted a small carbon pile, a compression spring, and a solenoid working in opposition to the spring. The solenoid is in series with the arc so that any variation in current will cause the solenoid to vary the pressure on the carbon pile, thereby keeping the current constant at the value it is adjusted for.

Three switches on the panel provide an easy means of current adjustment between 25 and 175 amperes. The arrangement of the welding circuit is such that 25 amperes always flow through the solenoid when the main switch is closed, whether the welding current is at the minimum of 25 amperes or the maximum of 175 amperes. The balance of the welding current is taken care of in by-pass resistances shunted around the solenoid.

This outfit can be furnished as a dynamotor unit,

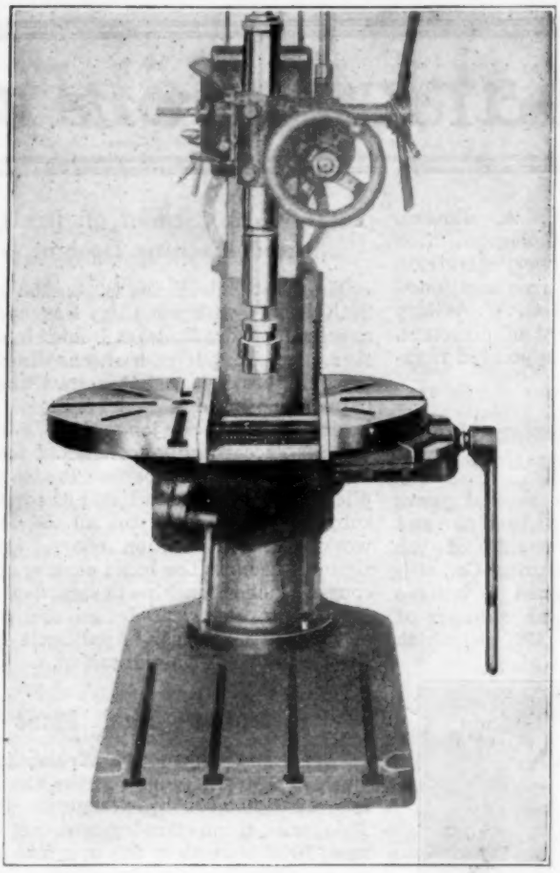


"PLASTIC-ARC" WELDING UNIT

with standard motor characteristics as follows: 110 volts or 220 volts direct current, or 220 or 440 volts, 60 cycle, 2 or 3 phase, alternating current; also as a gasoline-driven unit, or it can be furnished without a motor, to be belt driven. The normal generator speed is 1800 r.p.m. The net weight is 800 lb. with direct-current motor, 807 lb. with alternating-current motor, 1200 lb. with gasoline engine, and 550 lb. as a belted outfit without motor. The sets can be mounted on a truck for easy portability if desired.

"Quickgrip" Drilling Machine Table Vise

The device shown is designed to be used on a drilling machine either as a table or a vise. It is made by the Sprague-Hayes Manufacturing Co., 40 East Larned St., Detroit, Mich. The claims made for this device are that: the operator wastes no time hunting up a vise, hunting up bolts, bolting the vise to the table



SPRAGUE-HAYES QUICKGRIP DRILLING MACHINE TABLE VISE

Specifications: Diameter of table, closed, 16 in.; jaws open, 8 in.; size of table when open, 16 in. x 24 in.; steel jaw faces, 16 x 1¼ in.; weight, 115 lb.

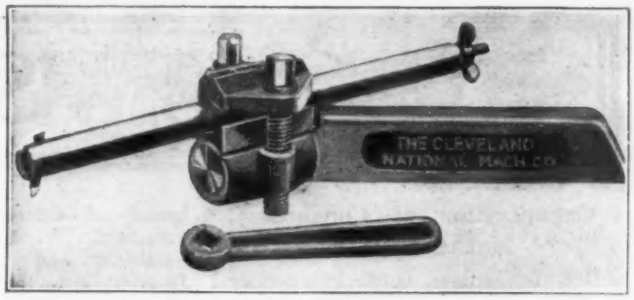
and removing it from the table when the job is finished; work is not marred by slipping drills or spoiled by turning or twisting under the drill; work being drilled need not be held by the hands.

The vise when opened furnishes a table 16 x 24 in. It will allow work to project below the face of the table to the base of the drilling machine. The vise will fit any drilling machine on the market. For this purpose it is only necessary to remove the regular table and fit the shank of the vise into the socket of the bracket. The vise shank is made large to allow for turning down to the correct size for the machine to which it is to be fitted.

The vise jaws are faced with machine steel (hardened jaws can be furnished on order) and are made interchangeable so that they can be replaced at any time without the trouble of fitting. The vise screw is 1¼ in. in diameter, four threads to the inch, and runs in a bronze nut. The ways are carefully machined. The table has four T-slots and is machined for accurate work.

Cleveland National Boring-Tool Holder

The adjustable boring-tool holder shown is made by the Cleveland National Machine Co., 1354 West 70th St., Cleveland, Ohio. The boring-bar holder can be rotated around the end of the shank so as to bring the bar at the height of the lathe center without blocking.

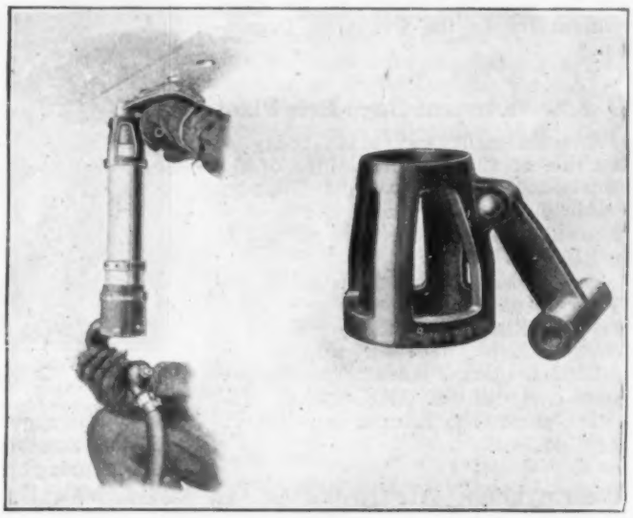


CLEVELAND NATIONAL BORING-TOOL HOLDER

The same screws that clamp the bar also lock the bar holder in position on the shank. The holder will take not only the special bar shown in place, but any round forged boring bar within its capacity. It will also hold indicators, drills or reamers. The regular shank is ½ x 1⅛ in., and the holder will take rounds from ⅜ up to ⅝ in. in diameter.

"Boyergrip" Pneumatic Hammer Holder

The device illustrated is known as the "Boyergrip" and is the product of the Chicago Pneumatic Tool Co., Fisher Building, Chicago, Ill. It combines a hammer grip with a safe set retainer and affords the operator a firm hold of the tool without danger of squeezed



THE BOYERGRIP

fingers or burns from the heated cylinder or hot rivets. It gives an unobstructed view of the work and provides protection in chipping when the chisel slips or is accidentally shot from the holder.

Note—American Adjustable Limit Gage

In our description of the American adjustable limit gage, given on page 439, the address of the manufacturer was given as Dayton, Ohio, owing to the fact that another concern of the same name is located in that city. The name and address of the company making the gage referred to is the American Gage Co., Newark, New Jersey.

Sparks from the

Organization of Consulting Mathematicians

Drs. T. Dantzig, G. A. Pfeiffer, and J. F. Ritt have formed the firm of Dantzig, Pfeiffer & Ritt, consulting mathematicians, 500 West 116th St., New York, to undertake solving industrial problems in which a knowledge of mathematics may be necessary. Dr. Dantzig is a graduate of the University of Paris and the Ecole Superieure d' Aëronautique et de Construction Mecanique. He has taught at Indiana University and Columbia. Dr. Pfeiffer received a degree of mechanical engineering from the Stevens Institute of Technology and the degree of doctor of philosophy from Columbia. He has taught mathematics at Harvard, Princeton and Columbia. He is associate editor of the *Annals of Mathematics*. Dr. Ritt took the degree of Ph.D. at Columbia, was for three years at the Naval Observatory and has taught mathematics at Columbia. During the war he was one of the chief ballisticians in the Ordnance Department.

* * *

U. S. Government Buys Erie Plant

Announcement was made today of the sale of the entire holdings of the American Brake Shoe and Foundry Co. in Erie to the United States Government. The consideration is said to be $495,835.

Under the terms of the deed, the Government obtains possession of three parcels of land near the city limits on West 12th St., together with all the buildings, plants, machinery and personal equipment of the company.

The plant is to be used as a Government arsenal.

* * *

Westinghouse Air Brake Co. to Extend Housing Facilities

The housing facilities which at present are inadequate at Wilmerding, Penn., the home of the Westinghouse Air Brake Co.'s Works, are to be extended at once by the erection of a number of new dwellings for the families of the employees.

An official announcement is made of the organization of the Westinghouse Air Brake Home Building Co., with a capital of $1,000,000 for the purpose of transacting all business relative to the real estate and dwellings which have been transferred by deed to this company by the Westinghouse Air Brake Co. It includes the ownership of over 400 houses and considerable vacant property in the Borough of Wilmerding and the adjacent territory.

The officials of the new organization are A. L. Humphrey, chairman of the board of directors; C. A. Rowan, president; W. S. Bartholomew, vice president; and H. C. Tener, secretary. In addition to the first three mentioned above, J. F. Miller and G. W. Wildin are included in the board of directors. S. R. Gittens has been appointed manager.

* * *

L. E. Strothman Resigns from Allis-Chalmers Co.

L. E. Strothman, for several years manager of the steam turbine and pumping engine departments of the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has resigned to become vice president and general manager of the Richardson-Phenix Co. in which

L. E. STROTHMAN

firm he has acquired a financial interest. Mr. Strothman is well known in manufacturing circles, having been connected with the Allis-Chalmers Co. since 1902 and prior to that with the Filer & Stowell Co. and the Nordburg Manufacturing Co. He is a member of the American Society of Mechanical Engineers, having held the chairmanship of the Milwaukee section during 1915 and 1916, and is also a member of the American Society of Civil Engineers and the American Water Works Association.

* * *

Wireless Telephone "Voice" Heard Four Miles

By means of the "Great Voice," a wireless magnifying telephone, installed at the direction of Gen. George Squier, Chief Signal Officer, U. S. A., the address of Vice President Marshall, delivered at Trinity Church Forum, Washington, Aug. 24, was heard throughout a radius of approximately 4 miles.

Y. M. C. A. School of Drafting and Machine Design

The East Side Y. M. C. A., 153 East 86th St., New York City, has opened a school of drafting and machine design, for the purpose of enabling the mechanic to increase his pay and to supply the need for draftsmen. The basic course is a job-getting course, and is accordingly conducted on a strictly professional basis. It also supplies the mathematical and theoretical subject prerequisite to all advanced work. A continuation course is designed to follow the basic course. This course teaches machine design, tool and jig design, electrical design and other specialized branches. Applicants must have a public school education.

* * *

To Enlarge Lima Plant

The Lima Locomotive Works, Lima, Ohio, announced plans for the expenditure of $1,250,000 to enlarge its plant. This will mean employment of 3000 men, 1000 more than the present maximum and will equip the plant to turn out 70 locomotives a month, it is reported.

At the same time, the Ohio Steel Foundry Co., which supplies the locomotive works, announces it will spend $200,000 to enlarge its plant.

The contracts for the locomotive extension are awaiting signatures.

* * *

E. W. Bliss Co. Buys Plant

Announcement has been made that the E. W. Bliss Co., of Brooklyn, has purchased the plant of one of its large competitors, the Consolidated Press Manufacturing Co., of Hastings, Mich. The price is said to be $1,000,000. The acquisition of the Michigan concern, which was a direct result of the heavily increased demand from abroad for dies, presses and steel machinery made upon the Bliss company, makes the shops controlled by the corporation the most extensive in the country.

* * *

General Electric Acquires Interest in Trumbull Co.

The General Electric Co. has acquired an interest in the Trumbull Electric Manufacturing Co. of Plainville, Conn. The present management of the Trumbull Electric Manufacturing Co. still retains a financial interest in the company and will continue in active charge of its manufacturing and selling policy.

The Trumbull Electric Co. manufactures knife switches and safety-first iron box inclosed switches, as well as a general line of miscellaneous supplies.

World's Industrial Forge

By E.C.Porter, News Editor

The American Chemical Society Will Discuss Patent Evils

The question of patent reform will be discussed by the American Chemical Society in a special symposium at the annual meeting of the society at the Hotel Bellevue-Stratford, Nov. 2-6 in Philadelphia. As every large industry in the United States is under chemical control the discussion is expected to develop a concerted movement.

One of the main points of discussion will center about a paper to be read by Dr. Bernard C. Hesse, in which he will advocate the collection of an annual fee from all inventors. If the holder of a patent is actually making use of his rights, the nominal fee would not embarass him in any way, but if he is merely holding papers for the purpose of blocking others and collecting a tribute he would be less likely to take out patents.

In a recent address Mr. Thomas Ewing, for many years United States Commissioner of Patents, drew attention to the need of a complete reorganization of the Patent Office.

"Congress," he said, "allows $3000 a year for the Patent Office to keep up with all the technical literature of all the arts. It ought to be $50,000, and it ought to be whatever is necessary beyond that, and yet it was absolutely impossible for me to get one dollar beyond the $3000 a year while I was there. There was a separate set of German patents, 200,000 in number, which we wished to bind by classes according to German classifications, so that searches might be made through them by the public, who are interested. It took me three years to get an appropriation of $20,000 to bind them, and during that whole time they were tied in bundles, because we did not dare open the bundles for fear numbers would be lost."

The advocates of reform believe that the Patent Office, which is now of the Interior Department, should be changed to an independent bureau, so it could get the necessary assistance from Congress to have all the equipment necessary for making its judgments certain and trustworthy. They declare that such action would save every year in the relief of business from the uncertainty of wrongly granted patents millions of dollars.

* * *

Demand for Tractors in Norway

Trade Commissioner N. A. Bengston, Christiania, Norway, writes that American-made tractors are in great demand in Norway and advises sending representatives to cover the field as soon as possible.

Personals

CAPTAIN EDWARD VAN WINKLE recently of the Engineers Corps announces his association with Frederick A. Waldron, consulting engineer, 37 Wall St., New York City, for the general practice of engineering with special reference to the problems relating to the construction, development, and operation of industrials. Captain Van Winkle served 18 months in France, Belgium, Luxemburg and Germany and was in the Argonne and St. Mihiel offensives. While with the American Expeditionary Forces, he was Engineer Officer of the Construction Troops which built the largest engineer depot in the advanced area, located at Issurtielle, being in charge of most of the design and of the field parties of this $19,000,000 project.

ALVIN R. WHITEHEAD, who recently resigned as purchasing agent of the American Condenser and Engineering Corp., Plattsburg, N. Y., has been made sales manager.

H. G. SCHWOEPPE has been appointed tool and jig designer at the Hart-Parr Co., Charles City, Iowa. Mr. Schwoeppe was formerly with the Buick Motor Co., Flint, Mich., and previous to this was connected with the Northway Motor Co., and the Wisconsin Motor Co., Milwaukee, Wis.

Obituary

A. S. CHISHOLM, assistant to President W. P. Palmer, of the American Steel and Wire Co., died suddenly this week, following a tennis game at the East End Tennis Club. He was stricken with heart disease, and died a few minutes later in St. Luke's Hospital. Apparently he was in good health until he collapsed. He was accompanied by his daughter and son-in-law. Other members of the family were in Maine.

Mr. Chisholm, who was 48 years old, had held his last position since 1899, when the Cleveland Rolling Mills Co., with which he was originally connected, was absorbed by the American Steel and Wire Co. Prior to that he had spent several years learning all branches of the production end of the business before taking up managerial work. He was a director in several of the largest industries in the Cleveland district, as well as financial institutions.

Trade Currents from Cleveland and Chicago Districts

CLEVELAND LETTER

The month of August will close with about three times as much business as has been done in any month since last November. This is the belief of leading machinery interests in the Cleveland, Ohio, district, based upon the larger number of orders received and the better class of equipment being taken. The automobile industry, as usual, is still the leading factor, and probably has the biggest influence in the increase in business owing to the fact that they are really planning new cars for the coming year, something that was prohibitive by reason of war-time conditions a year ago. The tremendous demands of the Government upon all classes of machinery producers here last year of course offset the chance of the past month being better, or even as good as August, 1918.

Local machinery interests see in the fewer inquiries for equipment they cannot fill a more stabilized market, and also an indication that consumers are practically certain of placing orders following inquiries where they can get that equipment.

The coming month will be significant, in the minds of producer and distributors here, in that it should bring to a settlement one way or another the labor situation. At the moment, settlement does not seem to be in sight. Several plants that usually can be depended upon in the general manufacturing field as large absorbers of equipment at this time are running part time only, if at all, because of the walkout of employees to enforce demands of one kind or another. Numerous such plants are affected already.

In spite of this condition, financial and other interests are going ahead with plans for development of the manufacturing industries of this territory. One of the latest to be announced this week is the proposal to open up 61 acres in the southern end of the city, with railroad facilities and side-track provision. The first plant to be erected in this tract probably will be for the General Bronze and Foundry Co., at present located at 49th St. and Hamilton Ave. Other large manufacturing interests are said to be negotiating for the greater part of the remaining acreage for their plants.

Inquiries have been received by several large local machinery interests during the last week or so from an indirect source which indicates that a large automobile plant, presumably to be started by Detroit interests, will be lo-

cated in Cleveland at an early date. The inquiries indicate that a $4000 motor car will be built by the firm, which is believed to be backed by the Lelands, of the Lincoln Motors Corporation. No confirmation of such backing has been received here as yet. Meanwhile negotiations for land, to the extent of 50 acres, in the Euclid, St. Clair, East 152nd St. and Bliss Road districts of the city, are under way.

Chicago Letter

In spite of numerous deterrent factors, business keeps up with most dealers to a surprising degree. For the moment, labor conditions in this territory are better than for some time in the past. The Crane Co. strike which began on July 11 and resulted in a complete shutdown of the plant has about ended, a majority of the 7000 employees having returned to work and the International Harvester Co. is also gradually resuming operations. Numerous smaller strikes have been settled, leaving the only big problem the lockout of the building trades, which affects the machinery trade in that it has stopped the erection of all additions to plants and all new plants. Federal mediators are here in an effort to adjust the trouble but, to date, have met with no success.

The pending strike vote of the railroad shopmen and the threat of a tieup of the steel industry, present a menace that undoubtedly operates to keep large concerns out of the buying field. On the other hand, a possibility of an attempt to force a closed shop on machinery manufacturers at Cincinnati and Rockford holds a threat of a cessation of production and impells manufacturers who need machines for specific purposes to place orders at once. Altogether, the outlook might be designated as "scrambled" and everyone interested is acting in accordance with their own best judgment. The combined effect on the market has been to continue conditions as they have been for two months past—the large corporations watchfully waiting and the smaller manufacturers buying tools as needed.

Dealers still feel anxious about the ultimate disposal of government-owned machinery. They feel, however, that the red tape and restrictions imposed on buyers of this material is tending to cause users to prefer to deal with the regular sources of supply. The requirement of a 10 per cent. certified check with bids and a possible delay of 60 days before an award is made makes the purchase of this material rather difficult and is keeping dealers from bidding in many instances. It is only reasonable to suppose that the user is similarly affected by these conditions.

Export business is affecting Chicago dealers only indirectly, in that the manufacturers are having no difficulty in disposing of surplus stock and may thereby be influenced in stiffening prices. A few changes have been noted in the past week, a maker of saws having withdrawn his lists and required inquiries to be submitted for quotation, pending issue of new list, and one or two other minor advances having been made.

Automobile builders continue to be the best customers, as is reflected not only by their present buying of tools, but by the continued stiff market on tin plate, of which they are large users. As the automobile business is directly dependent on the steel industry for raw materials, the continued strength of this buying factor is doubtful, pending the outcome of labor difficulties in the steel plants.

All dealers interviewed in the past few days report current sales on a par with any week during the past several months.

Trade Catalogs

Sullivan Drills. Sullivan Machinery Co., Chicago, Ill. Booklet No. 118; 5½ x 3½ in.; pp., 32. The Sullivan hammer drills and rock drills described in this booklet can be used for every kind of rock excavation, in mine, quarry or on public work.

Ball Retainers and S. A. E. Standard Inches of Ball Thrust Bearings. The Gwilliam Co., 253 West 58th St., New York City. Bulletin No. 2; 4½ x 7½ in.; pp. 22. This bulletin contains dimensions of thrust ball bearings, magneto bearings retainers, also S. A. E. standard inch sizes of thrust ball bearings.

Corkboard Insulation. Armstrong Cork and Insulation Co., Pittsburgh, Penn. Folder, telling of the various uses of Nonpareil corkboard insulation for cold-storage rooms, freezing tanks and other such purposes.

Drinking Water. Armstrong Cork and Insulation Co., Pittsburgh, Penn. Folder entitled "Saving 63 Per Cent. of the Drinking Water Expense," telling of the use of Nonpareil cork covering for cold-water purposes.

Motors and Generators. Marble-Card Electric Co., Gladstone, Mich. Bulletin No. 100; 6 x 9 in.; pp. 15. This bulletin describes and illustrates the construction of the company's line of direct-current types M. C. motors and generators. Illustrations of the various parts are presented.

Trackless Trains. Mercury Manufacturing Co., 4118 South Halsted St., Chicago, Ill. Catalog; 6 x 9 in.; pp., 18. This catalog instead of giving specifications and details shows a number of methods in which the tractor and trailers known as the Trackless Train can be utilized to advantage in plants of various types.

New Publications

Practical Shell Forging. By Clifford O. Bower. Two hundred and seventy-nine 6 x 9½-in. pages, 152 illustrations and 17 tables. Bound in heavy, dark blue, cloth boards. Published by Longmans, Green & Co., 4th Ave. and 34th St., New York. Price $10.50.

The author of this book is assistant manager of the ammunition department of W. G. Armstrong Whitworth & Co., and formerly of the ammunition department of Vickers Sons & Maxim, England. His long experience and exceptional opportunities to observe forging practice as applied to shell work, renders his book of unusual value. While the forging work and methods described are all handled from the English standpoint, the practice does not differ materially from that of the better class of shops in the United States. The book has been especially prepared for the use of engineers, forgers, shell-shop managers, inspectors, foremen, students and all engaged in projectile manufacture. It is also of value to those interested in after-the-war reorganization and conversion of power forging plants for purposes of commercial utility.

The descriptions of the mechanical processes of forging and handling shell steel are detailed and clear. A special feature is a considerable amount of data on the deformation and flow of steel under pressure, illustrated by photographs of striped wax under drawing of forging conditions.

The section dealing with materials describes the function of the shell case, the care necessary in selecting, testing and examining material, the form and size of ingots, and the percentage of discards. Next, the mechanical properties of shell steels and their relation to the chemical analysis is taken up. Following this is shown the procedure governing the manufacture of billets and the nicking and breaking off of billets. The mechanical-treatment section gives methods of forging, the correct temperature at which to forge, rate of cooling billets, pressure required to cause deformation, power required to pierce, effect of punch form, stream-line flow of metal, friction on punches and dies, eccentricity of forgings, alternative methods of working, drawing, permissible reduction and bottling or heading. Under tools and appliances are shown the handling and transportation of billets, marking of forgings, loading of furnaces, punches, piercing dies—their strength and design, extraction of forgings from dies, forge gages, drawing dies, forging slings, nose swaging dies and bottling dies. The section on heat-treatment is very complete and gives many details not ordinarily found. The equipment used is, of course, all of English make, but the hydraulic and other machinery does not differ materially from similar purpose American machines. In dealing with the re-heating and annealing furnaces, the author takes up the conditions desired in a furnace, classes of fuel used, the simple coal-fired furnace, the continuous furnace, special arrangements of preheated air furnaces, coal consumption per ton of billets heated, producers and producer gas, types of producer gas-fired furnaces, gas and coal-fired normalizing and annealing furnaces, heading and bottling furnaces, and methods of heat measurement.

Forthcoming Meetings

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Steel Treaters' Society will hold its annual convention and exhibition at the Seventh Regiment Armory, Chicago, Ill., Sept. 22 to 27. Al. J. Murphy, 154 East Erie St., Chicago, Ill., is chairman of the exhibit committee.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of each month, alternating with the Employers' Association of eastern Massachusetts. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting last Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

The National Safety Council will hold its eighth annual Safety Congress in Cleveland, Oct. 1 to 4 at Hotel Statler.

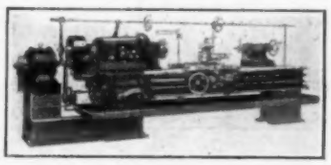
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Lathe, Type A. S.

Brodrene Sundt, Lakkegaten 55, Christiania, Norway

"American Machinist," Aug. 7, 1919

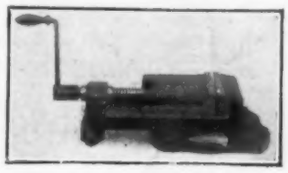


Made in five sizes, Type AS 8, AS 10, AS 12, AS 14 and AS 16, having swings over the ways of 430, 504, 600, 720 and 860 mm., respectively. Specifications for Type AS 12 machine; height of centers, 292 mm.; swing over ways, 600 mm.; swing over carriage, 430 mm.; length of bed, 2440 mm.; distance between centers, 900 mm.; width of bed, 460 mm.; front bearing, 100 x 156 mm.; hole through spindle, 55 mm.; diameter of tailstock spindle, 70 mm.; back gear ratio, 24:1; spindle speeds, 8 to 384 r.p.m.; horsepower required, 8.

Vise, Machine

Miller & Crowningshield, Greenfield, Mass.

"American Machinist," Aug. 14, 1919.

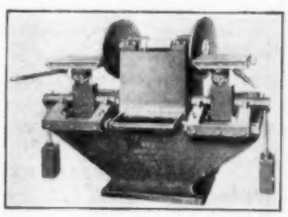


Made in two sizes, 4 and 5½. Swivel type jaws graduated so that they can be set any desired angle. Support under left end to prevent springing. No. 4 has jaw width 4 in., jaw height, 1¼ in., jaw opening, 2 in., weight, 22 lb., steel lever handle. No. 5½ has jaw width, 5½ in., jaw height, 1⅝ in., jaw opening, 3¼ in., weight, 45 lb., steel crank handle.

Grinding Machine, Disk

Badger Tool Co., Beloit, Wis.

"American Machinist," Aug. 14, 1919.



Lever feed table fitted with adjustably attached wheel-truing device, backstops, and micrometer screw stop. Toggle joint employed to lessen physical energy on part of operator. Pressure increases as table approaches grinding disk. Ball bearings protected by the type of mounting and provision made for draining off lubricant and cleaning housing. Rocker shaft mounted in saddle which provides a bearing support on each side of the box supporting the lever feed work table.

Set-Up Appliances, "Cad" Standardized

Standard Shop Equipment Co., Inc., 802-803 Real Estate Trust Bldg., Philadelphia, Penn.

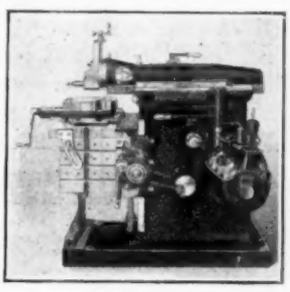
"American Machinist," Aug. 14, 1919.

These include standardized bolts and nuts, single- and double-end clamps and packing blocks. Bolts and nuts made in various sizes and lengths, bolts having double off-set on head to prevent turning. Nuts extra thick and case-hardened. Double-end clamps made in lengths of 3, 4, 5, 6, 7 and 9 in. Packing blocks made in 3-, 4- and 6-in. lengths and 2- to 3½-in. widths. Single-end clamps made in lengths of 2, 3, 3½, 4½ and 5½ in. with widths of 1¼, 2, 2, 2¼ and 2¼ in. respectively.

Shaping Machine, 16-in. Crank

Hendey Machine Co., Torrington, Conn.

"American Machinist," Aug. 14, 1919.

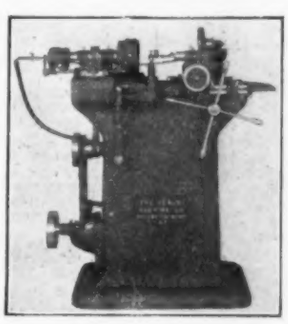


Actual stroke, 16½ in.; horizontal travel of table, 24 in.; vertical travel of table, 15 in.; minimum distance from ram to table, 4 in.; top of table, 14 x 16 in.; side of table, 13 x 15 in.; notches in power crossfeed, 35; range of power crossfeeds, 0.005 to 0.175 in. per stroke; ram bearing in frame, 10 x 29 in.; travel of head slide, 7 in.; power feed of head slide, 0.005 to 0.050 in.; opening of vise jaws, 12¼ in.; size of vise jaws, 12 x 2⅞ in.; keyseating capacity, 3 in.; size of tools, ⅝ x 1¼ in.; diameters of cone pulley, from 7½ to 13 in.; width of belt, 3 in.; net weight, 3000 lb.; floor space, 47 x 77 in.; 3½ hp. motor running at 400 to 1200 r.p.m., furnished if desired; silent chain drive.

Grinding Machine, No. 85 Internal

Heald Machine Co., Worcester, Mass.

"American Machinist," Aug. 14, 1919.

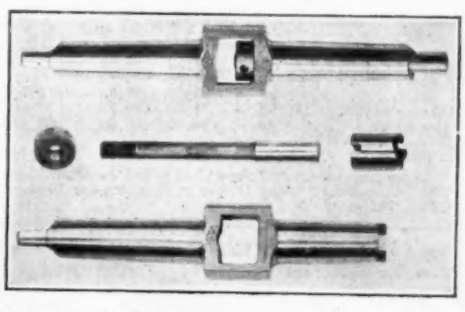


Swing without water guard, 10 in.; swing inside water guard, 6 in.; depth ground, 4 in.; length of base, 33 in.; table, 35 x 8⅜ in.; distance from floor to chuck spindle, 46 in.; diameter of work spindle bearings, 1⅝ and 1⅜ in.; hole through spindle 1⅛ in.; diameter of work spindle pulley, 4 in.; regular chuck furnished, 3-in. collet with adjustable jaws; head graduated for 45 deg. each side of center or up to 4-in. taper per ft.; work speeds, three, 161, 292, and 528 r.p.m.; floor space, 26 x 50 in.; speed of countershaft, 600 to 820 r.p.m.; tight and loose pulleys, 10 in. in diameter, 2¾-in. face; net weight, 1100 lb.

Tool, Counterboring and Facing

Chapin & Baker Manufacturing Co., 143 Edison St., Syracuse, N. Y.

"American Machinist," Aug. 14, 1919.

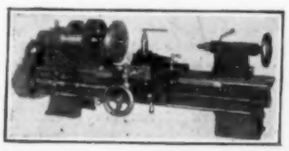


Holder is made of nickel steel, cutter of high-speed steel. Cutter secured to holder by means of an internal shoulder against which pilot is drawn by a capstan nut in center of holder. Teeth of cutter are ground with slight hook to make chips roll out freely, instead of being broken in small pieces. Tools are made in various sizes to suit the trade.

Lathe, Manufacturing, with Ball-Bearing Cone

Flather Manufacturing Co., Nashua, N. H.

"American Machinist," Aug. 7 and 21, 1919.



This 7-in. lathe has a swing over ways, approximately 8 in.; distance between centers, 15 in.; length of bed, 36 in.; hole through spindle, ⅞ in.; maximum capacity of draw-in collet chucks, ¾ in.; taper in front end of spindle, Morse No. 3; width of belt, 1¼ in.; spindle bearings, bronze; cone bearings, ball type; back gear ratio, 7:1; lead screw, ⅛ in. in diameter, with 10 acme threads; travel of cross-slide, 4½ in.; travel of compound rest, 1½ in.; countershaft, two-speed, double-friction type; weight of bench type machine, 300 lb.; weight of floor type machine with pan, 400 lb.; floor space, 24 x 42 in.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$30.35	$36.90
Northern Basic	27.55	27.55
Southern Ohio No. 2	28.55	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	32.40	34.40
Southern No. 2 (Silicon 2.25 to 2.75)	35.20	33.95
BIRMINGHAM		
No. 2 Foundry	28.00	33.00
PHILADELPHIA		
Eastern Pennsylvania No. 2	30.65*	30.65
Virginia No. 2	32.10–34.10†	30.85
Basic	30.90*	29.90
Grey Forge	29.90*	29.90
CHICAGO		
No. 2 Foundry local	26.75	26.75
No. 2 Foundry, Southern	28.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	28.15	28.15
Basic	27.15	32.00
Bessemer	29.35	35.20

* F. o. b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	— New York —			— Cleveland —		— Chicago —	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$3.47	$4.245	$3.37	$4.17	$3.47	$4.27
Soft steel bars	3.37	3.37	4.145	3.27	4.07	3.37	4.17
Soft steel bar shapes	3.37	3.37	4.145	3.27	4.17	3.37	4.17
Soft steel bands	4.07	4.07	4.995	....	....	....	....
Plates, ¼ to 1 in. thick	3.67	3.67	4.495	3.57	4.42	3.67	4.25

Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows.

	Current	One Year Ago
Mill, N. Y.	$2.77	$3.50
Warehouse, New York	3.37	4.75
Warehouse, Cleveland	3.27	4.10
Warehouse, Chicago	3.37	4.10

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	St. Louis	Chicago	San Francisco	— New York — Current	One Yr. Ago
No. 10	3.55	4.64	4.57	5.80	4.57	5.495
No. 12	3.60	4.69	4.62	5.75	4.62	5.545
No. 14	3.65	4.74	4.67	5.90	4.67	5.595
No. 16	3.75	4.84	4.77	6.00	4.77	5.695
Black						
*Nos. 18 and 20	4.15	5.24	5.42	6.75	5.30	6.295
*Nos. 22 and 24	4.20	5.29	5.47	6.80	5.35	6.345
*No. 26	4.25	5.34	5.52	6.95	5.40	6.395
*No. 28	4.35	5.44	5.62	7.05	5.50	6.495
Galvanized						
No. 10	4.70	5.79	5.97	....	6.20	6.845
No. 12	4.80	5.89	6.07	7.30	6.25	6.945
No. 14	4.80	5.89	6.07	7.30	6.30	6.945
Nos. 18 and 20	5.20	6.19	6.37	7.60	6.60	7.245
Nos. 22 and 24	5.25	6.34	6.52	7.75	6.30	7.295
*No. 26	5.40	6.04	6.67	7.90	6.45	7.445
*No. 28	5.70	6.79	6.97	8.20	6.75	7.745

* For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago
Round shafting or screw stock, per 100 lb. base	$5.00	$4.90
Flats, squares and hexagons, per 100 lb. base	5.50	5.40

DRILL ROD—Discounts from list price are as follows at the places named:

New York	50%
Cleveland	50%
Chicago	50%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$21.00–26.00	$15.50–19
Cleveland	20.00	20.00
Chicago	16.50	19.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
1/16, 5/64, 3/32, 7/64, 1/8 No. 8, 9/64 and No. 10	21.00 to 30.00	1/4 by 12 in. long	14.00
No. 12		1/4 by 19 in. long	12.00
5/32 No. 14 and 3/16		5/16 by 19 in. long	10.00
No. 18		3/8 by 21 in. long	10.00
No. 20		**Special Welding Wire, Coated**	
Domestic 20c. for 1/16, 15c. for 1/8 to 1/4.		1/16	33.30
		5/64	30.00
		1/8	38.00

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	6.50	8.00	8.00
Spring steel (light)	10.00	11.25	11.00
Coppered bessemer rods	8.00	8.00	6.75
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	8.40	8.25	7.50
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

BUTT WELD

Inches	Steel Black	Steel Galvanized	Inches	Iron Black	Iron Galvanized
1/8, 1/4 and 3/8	50½%	24%	3/8 to 1¼	39½%	23½%
1/2	54½%	40%			
3/4 to 3	57½%	44%			

LAP WELD

2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%

BUTT WELD, EXTRA STRONG PLAIN ENDS

1/8, 1/4 and 3/8	46½%	29%	3/8 to 1¼	39½%	24½%
1/2	51½%	39%			
3/4 to 1¼	55½%	43%			

LAP WELD, EXTRA STRONG PLAIN ENDS

2	48½%	32%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	— New York — Black	— New York — Galvanized	— Cleveland — Black	— Cleveland — Galvanized	— Chicago — Black	— Chicago — Galvanized
⅛ to 3 in. steel butt welded	47%	31%	43½%	34½%	57½%	44%
2½ to 6 in. steel lap welded	42%	27%	45½%	30½%	53½%	41%

Malleable fittings. Class B and C, banded, from New York stock sell at plus 12½% less 5%. Cast iron, standard sizes, 10–5% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	24.00	21.75	26.00
Tin in 5-ton lots	56.00	70.00	92.00
Lead	5.90	5.50	8.75
Spelter	7.95	8.00	9.00
ST. LOUIS			
Lead	5.75	5.25	8.50
Spelter	7.60	7.65	8.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	— New York — Current	— New York — One Month Ago	— New York — One Year Ago	— Cleveland — Current	— Cleveland — One Year Ago	— Chicago — Current	— Chicago — One Year Ago
Copper sheets, base	33.50	29.50	38.00	35.50	38.00	36.50	33.50
Copper wire (carload lots)	28.25	26.00	35.00	30.50	35.00	26.00	33.00
Brass sheets	32.00	23.00	39.75	33.00	37.00	28.00	31.50
Brass pipe	46.00	34.00	46.00	39.00	42.00	37.00	41.50
Solder (half and half) (case lots)	45.00	45.00	60.00	41.00	57.50	38.50	56.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extras:

	Current	One Year Ago
Mill	$26.75	$32.25
New York	31.00	34.25
Cleveland	29.00	35.00
Chicago	27.00	29.50

Shop Materials and Supplies

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f. o. b. mill 11.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	12.50	18.75	13.00	18.40
New York	11.50	16.50	12.50	17.00
Chicago	16.50	22.00	16.00	21.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	9.50	14.00
Chicago	10.25	15.25
Cleveland	12.00	16.25

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland		
	Current	One Year Ago	Current	One Year Ago	Chicago
Copper, heavy and crucible	17.00	24.00	18.00	24.00	18.50
Copper, heavy and wire	16.00	22.50	19.00	23.50	18.00
Copper, light and bottoms	14.00	20.50	17.00	21.50	17.00
Lead, heavy	4.75	7.00	5.00	.....	5.00
Lead, tea	3.75	5.25	3.50	7.50	4.00
Brass, heavy	10.50	14.75	14.00	16.00	18.00
Brass, light	7.50	11.00	10.50	12.50	11.00
No. 1 yellow brass turnings	10.00	13.50	11.50	14.00	11.00
Zinc	5.00	6.00	5.00	6.50	6.00

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb.	35c.–37c	32.00c.@33.00c.	33½c.

COPPER BARS from warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York	33.00	32.00
Chicago	31.00	38.00
Cleveland	35.00	36.50

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	125.00	75.00	103.00	60.00	75.00
Commercial	50.00	70.00	16.50	23.00	13.00	16.50

SHOP SUPPLIES

New York prices will be revised in next week's issue.

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	$1.50	+$2.50	$2.25	$1.20	$1.85	$1.05
Hot pressed hexagon	1.50	+2.50	2.25	1.00	1.85	.85
Cold punched hexagon	1.50	+2.50	2.25	.75	1.30	1.00
Cold punched square	1.50	+2.50	2.25	.75	1.30	1.00

Semi-finished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	50-10%	50%
Chicago	50%	50%
Cleveland	60-10-10%	50%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	50%	50%	50–5%
Larger and longer up to 1½ in. by 30 in.	40%	40%	40–5%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York $1.25 Cleveland $3.75 Chicago $3.00

For cast-iron washers the base price per 100 lb. is as follows:

New York $6.00 Cleveland $3.75 Chicago $4.25

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	45–5%	40–5%	50–5%
Larger and longer up to 1 in. by 30 in.	35%	37½%	30–10%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	List plus 10%	10%	List plus 10%
Chicago	20%	List price	20%	List plus 20%
New York	40%	20% from list	20%	List plus 20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	50–10%	55% off	55%
Tinned	50–10%	55% off	55%

Boiler, ½, ⅝, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York $5.25 Cleveland $4.00 Chicago $4.87 Pittsburgh $4.65

Structural, same sizes:

New York $5.35 Cleveland $4.10 Chicago $4.97 Pittsburgh $4.75

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	37.50	41.50	38.50
Brass	36.00	39.00	37.00

For immediate stock shipment 3c. is usually added. The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb., the advance is 5c. over base (100-lb. lots); for less than 50 lb., but not less than 25 lb., 10c. should be added to the base price; and for quantities of from 10 to 25 lb. the extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet-metal mouldings if ordered in above quantities. The above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ¼ up to 2 in. inclusive in rounds, and ¼ up to 1½ in., inclusive in square and hexagon—all varying by thirty-seconds up to 1 in. and by sixteenths over 1 in. On all shipments aggregating less than 100 lb. there is usually a boxing charge of $1.50.

LONG TERNE PLATE—For No. 28 primes, from Stock, the price in Chicago is $7.50 per 100 lb.

COTTON WASTE—The following prices are in cents per pound:

	New York		Cleveland	Chicago
	Current	One Year Ago		
White	13.00	11.00–13.00	14.00	11.00 to 14.00
Colored mixed	9.00 to 12.00	8.50–12.00	11.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13¼ x 13¼	13¼ x 20½
Cleveland	52.00	58.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$1.75	$1.75	$1.75
Philadelphia	1.75	1.75	1.75
Cleveland	2.75	2.75	2.40
Chicago	2.00	2.00	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.65	$3.65	$4.30
Cleveland	3.62	3.62	4.60
Chicago	4.12½	4.125	4.00

COKE—The following are prices per net ton at ovens, Connellsville, and cover the past five weeks:

	Aug. 27	Aug. 21	Aug. 14	Aug. 7	July 31
Prompt furnace	$4.85	$4.00	$3.90	$3.90	$3.85
Prompt foundry	5.50	5.50	5.25	5.00	5.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	per ton	$8.00
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$2.25	$1.86	$2.50	$2.10	$2.48	$2.05
5-gal. cans	2.40	1.96	2.75	2.25	2.68	2.25

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		1 Year Ago		Current	1 Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100-lb. keg	13.00	14.50	14.00	14.50	13.00	14.00
25 and 50-lb. kegs	13.25	14.75	14.25	14.75	13.25	14.25
12½-lb. keg	13.50	15.00	14.50	15.00	13.50	14.50
5-lb. cans	15.00	16.50	.....	.....	15.00	16.00
1-lb. cans	16.00	17.50	.....	.....	16.00	17.00

500 lb. lots less 10% discount; 2000 lb. lots less 10-2½% discount.

NEW AND ENLARGED SHOPS

Consult the Buying Section when in need of machinery or supplies

Metal Working

NEW ENGLAND STATES

Conn., Ansonia—The H. C. Cook Co., Beaver St., manufacturer of brass and metal novelties, has awarded the contract for a 1 and 2 story, 60 x 250 ft. factory. Estimated cost, $40,000. Noted July 3.

Conn., Bantam—The Bantam Ball Bearing Co. is having plans prepared by Fletcher-Thompson, Inc., Engr., 1089 Broad St., Bridgeport, for 2 story, 50 x 300 ft. factory. Estimated cost, $65,000.

Conn., Bridgeport—The city has awarded the contract for a 2 story, 150 x 200 ft. garage, stable and storage building, to be erected at Seaside Park. Estimated cost, $50,000. Noted Aug. 14.

Conn., New Britain—The Stanley Rule and Level Co., 111 Elm St., has awarded the contract for a 3 and a 5 story 30 x 36 and 40 x 60 ft. factories. Estimated cost, $38,000.

Conn., Stratford (Bridgeport P. O.)—The Raybestos Co., Bostwick and Railroad Ave., manufacturer of brake lining, has awarded the contract for a 3 and a 5 story, 30 x factory, to be erected on East Main St. Estimated cost, $45,000.

Conn., Waterbury—The city will build a 1 story garage on Field St. Estimated cost, $30,000. F. A. Webster, 51 West Main St., Arch.

Mass., Greenfield—The American Tap and Die Co., 16 Arch St., has awarded the contract for a 1 and 2 story factory and office. Estimated cost, $35,000.

Mass., Millbury—A. C. Jackson, Oxford, has awarded the contract for a 2 story, 60 x 80 ft. garage, to be erected on South Main St. Estimated cost, $25,000.

Mass., Springfield—H. W. McLarren, Cypress and Fulton St., will build a 1 story, 65 x 75 ft. machine shop. Estimated cost, $20,000.

Mass., Worcester—A. I. Asher, 16 Harding St., is having plans prepared by E. T. Chapin, 340 Main St. for a 2 story, 152 x 163 ft. garage, to be erected on Green St. Estimated cost, $150,000.

Mass., Worcester—The Coppus Engineering and Equipment Co., Inc. Park Ave., manufacturer of turbine blowers and pumps, plans to build a 1 story foundry. Estimated cost, $80,000.

Mass., Worcester—The Leland Gifford Co., 1025 Southbridge St., machinists, has awarded the contract for a 2 story factory. Estimated cost, $50,000.

SOUTHERN STATES

W. Va., Fairmont—The West Virginia Metal Products Co., has had plans prepared by Dreher, Churchman, Paul & Ford, Arch., 1424 Walnut St., for a 1 story, 280 x 360 ft. factory.

MIDDLE ATLANTIC STATES

Md., Annapolis—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has awarded the contract for a garage to be erected here. Estimated cost, $29,058. Noted July 3.

Md., Baltimore—The Horowitz Garage Co., 1001 East Baltimore St., has had plans prepared by G. R. Callis, Jr., Arch., 55 Knickerbocker Bldg., for a 2 story, 60 x 140 ft. garage, to be erected at 109-13 North High St. Estimated cost, $50,000.

Md., Baltimore—The Simmons Co., 612-22 West Pratt St., has purchased a site on Key Highway near Fort Ave., and plans to build a warehouse and factory, for the manufacture of brass and iron beds and bed springs. Estimated cost, $75,000.

N. J., Newark—The American Platinum Works, Railroad Ave., has awarded the contract for the erection of a 3 story, 50 x 130 ft. plant. Estimated cost, $100,000.

N. Y., Buffalo—The Niagara Machine Tool Co., 683 Northland Ave., plans to build a 1 story, 90 x 108 ft. addition to its machine shop. Estimated cost, $75,000 H. E. Plumer, Ellicott Sq., Arch.

N. Y., Buffalo—The Wire Wheel Corporation of America, 1700 Elmwood Ave., has awarded the contract for a 1 and 2 story, 59 x 195 ft. forge shop and factory. Estimated cost, $65,000.

N. Y., Dunkirk—The American Locomotive Works, North Jay St., Schenectady, have awarded the contract for a 1 story, 70 x 244 ft. carpenter shop, to be erected here. Estimated cost, $70,000. Noted Aug. 21.

N. Y., New York (Borough of Bronx)—The American Radiator Co., 104 West 42nd St., has awarded the contract for a 2 story, 115 x 185 ft. factory, to be erected on Exterior and 149th St. Estimated cost, $120,000.

N. Y., New York (Borough of Bronx)—J. Pederson, 3rd Ave. and 148th St., will build a 1 story, 65 x 155 ft. garage on West Farms Road and 176th St. Estimated cost, $30,000. Noted Aug. 14.

N. Y., New York (Borough of Brooklyn)—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has awarded the contract for the erection of a garage at the Medical Supply Base, here. Estimated cost, $61,200. Noted May 15.

N. Y., New York (Borough of Brooklyn)—The Fush Bocker Improvement Co., 391 Christopher Ave., will build a 1 story, 100 x 125 ft. garage on George St., Knickerbocker and Flushing Ave. Estimated cost, $35,000.

N. Y., New York (Borough of Brooklyn)—The Libond Realty Co., 44 Court St., will build a 1 story, 100 x 160 ft. garage on 35rd St. near 4th Ave. Estimated cost, $35,000.

N. Y., New York (Borough of Broklyn)—The M. C. K. Contracting Co., 2168 Dean St., will build a 1 story, 100 x 100 ft. garage on Fulton and Sackman St. Estimated cost, $25,000.

N. Y., New York (Borough of Brooklyn)—F. Schwartz, 5323 6th Ave., will build a 1 story, 40 x 100 ft. garage, on Atlantic Ave. near Albany Ave. Estimated cost, $18,000.

N. Y., New York (Borough of Brooklyn)—J. B. Sillman, 1511 Emmons Ave., will build a 2 story, 100 x 150 ft. garage on Pearl St. Estimated cost, $40,000.

N. Y., New York (Borough of Brooklyn)—J. Trainer, 228 York St., will build a 1 story, 30 x 100 ft. garage. Estimated cost, $15,000.

N. Y., New York (Borough of Manhattan)—The Buick Automobile Repair Co., 244 West 49th St., has awarded the contract for a 1 story, 100 x 200 ft. garage, to be erected on 54th St. near 8th Ave. Estimated cost, $400,000. Noted Mar. 6.

N. Y., New York (Borough of Manhattan)—C. Cory & Co., 290 Hudson St., has had plans prepared for a 6 story, 75 x 150 ft. factory, for the manufacture of electrical supplies. R. C. Cory, Arch., 39 Cortlandt St., will receive bids about Sept. 10. Noted Aug. 28.

N. Y., New York (Borough of Manhattan)—Cunes & Posta, 73 West Washington St., has awarded the contract for a 5 story, 100 x 130 ft. garage, to be erected at 541-551 West Broadway. Estimated cost, $100,000. Noted June 12.

N. Y., Seneca Falls—The Westcott Valve Co., Erie, Penn., plans to build a 1 story factory on Green and Spring St., here. Total estimated cost, including equipment, $100,000. Address P. R. Westcott, 73 Cayuga St.

N. Y., Syracuse—The Durston Gear Co., 213 Maltbie St., has awarded the contract for a 2 story, 75 x 200 ft. factory, to be erected on Leavenworth Ave. Estimated cost, $15,000.

N. Y., Utica—The Board of Education is having plans prepared by E. J. Berg, Arch., 223 Elizabeth St., for a school including industrial shops, to be erected on Mohawk St. Estimated cost, between $300,000 and $350,000. Address J. Kemper, City Engr.

Penn., Philadelphia—P. Grant, 113 Chestnut Ave., will build a 2 story, 50 x 98 ft. garage and machine shop, on Marsden and Longshore Rd. E. A. Wilson, 1218 Chestnut St., Arch. Noted Aug. 7.

Penn., Philadelphia—The Hood Manufacturing Co., 19th and Westmoreland St., has awarded the contract for a 3 story, 80 x 140 ft. factory, for the manufacture of machinery parts. Estimated cost, $120,000.

Penn., Philadelphia — The Philadelphia Drying Machine Co., 3351 Stokley St., has awarded the contract for a 3 story, 80 x 170 ft. factory, to be erected on Stokley and Westmoreland St. Estimated cost, $45,000.

Penn., Pittsburgh—The California Ave. Garage Co., California Ave. and Challis St., has awarded the contract for the erection of a 1 story, 60 x 95 ft. garage. Estimated cost, $25,000.

Penn., Pittsburgh —The Duff Manufacturing Co., Preble Ave., manufacturer of lifting jacks, is building a 1 story, 80 x 160 ft. forge shop and heat treating building.

MIDDLE WEST

Ill., Belleville—The Supr-Powr Piston Ring Co. plans to build a plant for the manufacture of piston rings. Address J. F. Seib, Gen. Mgr., Modern Die and Plate Press Manufacturing Co.

Ill., Chicago—The Cadillac Automobile Co., 2301 South Michigan Ave., will build a 3 story, 100 x 150 ft. service station on Indiana Ave. and 23rd St. Estimated cost, $100,000. Marshall & Fox, 721 North Michigan Ave., Arch.

Ill., Chicago—The Gramm-Bernstein Motor Truck Co., East Wayne and Scott St., Lima, Ohio, plans to build a 2 story, 70 x 190 ft. automobile service and sales building, at 2439 Wabash Ave., here. Estimated cost, $150,000.

Ill., Chicago—The Hill Pump Valve Co., 2307 Archer Ave., has awarded the contract for a 1 story factory, to be erected on Belmont Ave. and Knox St., for the manufacture of metal specialties. Estimated cost, $100,000.

Mich., Detroit—The Fruehauf Trailer Co., 1371 Cratiot Ave. manufacturer of automobile trailers, has had plans prepared for a 1 and 2 story, 100 x 260 ft. factory, to be erected on Dequindre St. near the Detroit Terminal R.R. Stahl & Kinsey, 435 Woodward Ave., Arch. Noted Aug. 7.

Mich., Detroit—Young Bros., 313 Franklin St., will build a 1 and 2 story, 105 x 161 ft. core-iron factory, on Beufait Ave. C. W. Brandt, 1114 Kresge Bldg., Arch.

Mich., Highland Park (Detroit P. O.)—The Maxwell Motor Co., Oakland Ave., has had plans prepared by Smith, Hinchman & Grylls, Arch., Washington Arcade, for a 1 and 2 story, 315 x 557 ft. factory to be erected on Oakland and Massachusetts Ave. Noted Aug. 28.

Ohio, Cleveland—The Automobile Equipment Co., Blackstone Bldg., will build a 2 story, 65 x 100 ft. factory on Prospect Ave. Estimated cost, $60,000. J. M. Miller, Guardian Bldg., Arch.